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U.S. Tuna Trade

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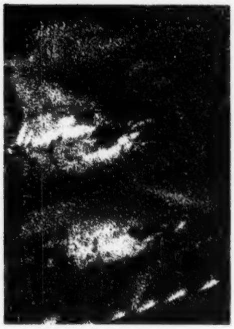

On the cover: Yellowfin tuna photographed inside a purse seine by William L. High, NMFS Northwest and Alaska Fisheries Center, Seattle, WA 98112.

Articles 46(1)

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U.S. Tuna Trade Summary, 1982

SAMUEL F. HERRICK, Jr.

Introduction

During 1982 there was a substantial decline in U.S. canned tuna sales, cannery receipts of domestically caught and imported raw tuna, and domestic production activity. Preliminary information indicates that total U.S. cannery receipts (domestic catches plus imports) of albacore, *Thunnus alalunga*, and tropical tunas (skipjack tuna, *Euthynnus pelamis*; yellowfin tuna, *T. albacares*; bluefin tuna, *T. thynnus*; and bigeye tuna, *T. obesus*) were down 16 percent from 1981 and 17 percent below the 1977-81 average volume of annual receipts (Table 1).

Canned tuna production during 1982 was off about 14 percent from 1981; a decrease of 18 percent for light meat (tropical species), and a 3 percent increase for white meat (albacore) packs. Compared with the 1977-81 annual average, the 1982 total pack was down 12 percent, reflecting a 15 percent decrease in the light meat pack and no change in the white meat pack (Table 2).

Table 1.—Estimated total U.S. cannery receipts (short tons) of albacore and tropical tunas 1981-82.

Species	1981	1982	% Change	1977-81 avg.	% Change
Albacore	102,167	101,183	− 1	103,154	− 2
Tropical	495,535	399,087	−20	501,888	−20
Total	597,702	500,270	−16	605,047	−17

Source: Statistics and Market News, Southwest Region, NMFS, NOAA.

Table 2.—Estimated U.S. canned tuna production, 1981-82 (thousands of standard cases[1]).

Pack	1981	1982	% Change	1977-81 avg.	% Change
White	5,826	6,012	3	6,012	0
Light	25,928	21,221	−18	24,948	−15
Total	31,754	27,233	−14	30,960	−12

[1]A standard case consists of 48 6.5-ounce cans. Source: NMFS Statistics and Market News, Southwest Region.

Popular accounts attribute the 1982 tuna industry downturn to a number of factors, including a drop in sales, an apparent excess of beginning canned inventories, and foreign competition. These conditions led to shutdowns and slowdowns in the canning operations of the three major U.S. tuna processors[1]: Bumble Bee Seafoods, a division of Castle and Cooke, closed its San Diego, Calif., plant in June 1982, idling 900 workers; the leading producer, Starkist, Heinz Foods, imposed a 3-week work stoppage at its plants in San Pedro, Calif., in Puerto Rico, and in American Samoa; and Van Camp Seafoods, Ralston Purina, reduced operations at its San Diego cannery. All processors imposed 40-60 day tie-up periods for those tuna seiners in which they held a major interest.

Owing to market conditions, the midrange wholesale list price of advertised light meat tuna fell from $51.00 per standard case in January 1982 to $45.65 in December 1982, a 10 percent decrease. The midrange wholesale list price of advertised white meat tuna rose initially in 1982, but then fell from $66.05 in May to $62.48 in December, a decline of 5 percent.

Market conditions also led to the reduction in ex-vessel prices experienced by domestic fishermen in 1982. The average ex-vessel prices paid by U.S. processors since August 1982 ranged from $795 per short ton for skipjack tuna to $1,036 per short ton for yellowfin/bigeye tuna—decreases of approximately 24 and 14 percent, respectively, from 1981. The top ex-vessel price for albacore (accounting for size differentials) fell about 25 percent during 1982, from $1,800 per short ton at the close of 1981 to $1,350 per short ton at the close of 1982.

Since the United States has historically imported far more raw tuna than it catches, the situation within the U.S. tuna industry during 1982 has had a global impact. Total cannery receipts of imported raw tuna declined about 24 percent from 1981 to 1982, reflecting decreases of 32 and 39 percent, respectively, for skipjack and yellowfin/bigeye tuna, but an increase of about 7 percent for albacore.

In the following sections of this paper, preliminary information pertaining to the production of raw and processed tuna by the U.S. tuna industry during 1982 is reviewed in more detail. In the last section, the economic impact of reduced tuna harvesting and processing activity during 1982 is analyzed for the California-based segment of the U.S. tuna industry.

[1]Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

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Cannery Receipts

Preliminary U.S. Cannery Receipts of Domestically Caught Tuna

Domestically caught[2] albacore, skipjack, and yellowfin (includes relatively minor amounts of bluefin, bigeye, and blackfin tuna, *T. atlanticus*) tuna, the major market species, comprised 45 percent of the total reported U.S. cannery receipts for 1982, up from 40 percent in 1981. However, while domestically caught receipts as a proportion of total U.S. cannery receipts increased in 1982, reported total receipts of domestically caught major market species declined, reflecting a disproportionate decrease in the amount of 1982 fresh and frozen tuna imports. Total domestically caught receipts, 227,784 short tons, were down about 5 percent, with albacore and yellowfin tuna off 56 and 6 percent, respectively, while domestically caught receipts of skipjack tuna increased about 5 percent. Yellowfin tuna comprised over 52 percent of the total domestically caught, U.S. cannery receipts of major market species in 1982, with albacore and skipjack tuna contributing about 3 percent and 45 percent, respectively, of the total (Table 3).

Table 3.—Domestically caught U.S. cannery receipts[1] (short tons) of albacore, skipjack, and yellowfin (including bluefin, bigeye, and blackfin) tuna by landings site, 1981-82.

	Continental[2]			Am. Samoa/Hawaii			Puerto Rico			Total		
Species	1981	1982	%[3]	1981	1982	%	1981	1982	%	1981	1982	%
Albacore	14,109	4,713	−66	757	1,868	146	2	3	50	14,868	6,584	−56
Skipjack	63,305	56,164	−11	20,522	26,600	30	13,950	19,691	41	97,777	102,455	5
Yellowfin	85,581	79,588	−7	14,535	13,926	−4	26,049	25,231	−3	126,165	118,745	−6
Total	162,995	140,465	−14	35,814	42,394	18	40,001	44,925	12	238,810	227,784	−5

[1]Includes only U.S.-caught tuna destined for U.S. canneries; excludes U.S.-caught tuna landed at foreign sites, U.S.-caught tuna landed at U.S. sites destined for foreign canneries, and U.S.-caught tuna destined for the fresh-fish market. Source: NMFS Statistics and Market News, Southwest Region.
[2]U.S.-caught tuna received at California canneries includes fish transshipped from Oregon, Washington, Alaska, Hawaii, Guam, the U.S. Gulf and East Coasts, and other areas.
[3]A % symbol denotes the percent change between 1981 and 1982.

Table 4.—Domestically caught U.S. cannery receipts[1] (short tons) by species and ocean of origin, 1981-82.

	Albacore			Skipjack tuna			Yellowfin tuna[3]			Total		
Ocean	1981	1982	%[3]	1981	1982	%	1981	1982	%	1981	1982	%
E. Atlantic	2	0	−100	3,327	0	−100	1,966	0	−100	5,295	0	−100
W. Atlantic	0	0	0	109	0	−100	502	115	−77	611	115	−81
E. Pacific	13,202	4,713	−64	73,770	57,098	−23	109,354	92,967	−15	196,326	154,778	−21
W. Pacific	1,644	1,871	14	20,571	45,357	120	14,343	25,662	79	36,578	72,890	99
Indian	0	0	0	0	0	0	0	0	0	0	0	0
Total	14,868	6,584	−56	97,777	102,455	5	126,165	118,744	−6	238,810	227,783	−5

[1]Includes only U.S.-caught tuna destined for U.S. canneries; excludes U.S.-caught tuna landed at foreign sites, U.S.-caught tuna landed at U.S. sites destined for foreign canneries, and U.S.-caught tuna destined for the fresh-fish market. Source: NMFS Statistics and Market News, Southwest Region.
[2]A % symbol denotes the percent change between 1981 and 1982.
[3]Also includes bluefin, bigeye, and blackfin tuna.

Pacific-caught tuna accounted for over 99 percent of the domestically caught U.S. tropical tuna received at U.S. canneries in 1982. The eastern Pacific provided most of the domestically caught, Pacific-wide tropical tuna receipts, 154,778 short tons, or 68 percent of the Pacific total. Domestically caught receipts from the eastern Pacific consisted of 57,098 short tons of skipjack tuna and 92,967 short tons of yellowfin tuna, 56 and 78 percent, respectively, of the estimated total domestically caught receipts of each of these species in 1982. Domestically caught tropical tuna receipts from the western Pacific during 1982 are estimated to be 72,890 short tons; 45,357 short tons of skipjack tuna and 25,662 short tons of yellowfin tuna (44 and 22 percent, respectively, of the estimated 1982 total domestically caught receipts of each of these species).

In 1982, domestically caught tuna receipts from the Atlantic Ocean consisted of 115 short tons of blackfin tuna which are included in the U.S. receipts under yellowfin tuna. While domestically caught tuna receipts from the Atlantic and eastern Pacific Oceans declined about 98 and 21 percent, respectively, during 1982, there was a 99 percent increase in domestically caught tropical tuna receipts from the western Pacific. All U.S. cannery receipts of domestically caught albacore during 1982 came from the north Pacific Ocean. Table 4 presents preliminary estimates of 1982 domestically caught U.S. cannery receipts by species and ocean of origin.

The major U.S. tuna receiving and processing sites are San Diego and San Pedro, Calif.; Mayaguez and Ponce, Puerto Rico; Honolulu, Hawaii; and Pago Pago, American Samoa. For reporting purposes, tuna receipts are combined for California sites (Continental) and for American Samoa and Hawaii (American Samoa/Hawaii). Sixty-one percent of the domestically caught U.S. receipts in 1982 were received at Continental sites and 19 percent and 20 percent of the total were received in American Samoa/Hawaii and Puerto Rico, respectively. U.S. cannery receipts at the Continental sites totaled 140,465 short tons in 1982, a 14 percent reduction from 1981. Receipts in American Samoa/Hawaii of U.S.-caught tunas totaled 42,394 short tons in 1982, an increase of about 18 percent over those for 1981. Puerto Rican receipts of U.S.-caught tuna in 1982 totaled 44,925 short tons, an increase of about 12 percent compared with

[2]Includes only U.S.-caught tuna destined for U.S. canneries; excludes U.S.-caught tuna landed at foreign sites, U.S.-caught tuna landed at U.S. sites destined for foreign canneries, and U.S.-caught tuna destined for the fresh-fish market. Cannery receipt figures will not correspond to those for U.S. tuna landings.

1981. The distribution of preliminary 1982 U.S. tuna receipts by species and cannery site is shown in Table 3.

In 1982, receipts of U.S.-caught albacore and tropical tunas generated about $237 million in ex-vessel revenues, down 16 percent from 1981. Domestically caught, U.S. albacore receipts produced ex-vessel revenues of about $9 million, 67 percent below 1981, which, when divided by total volume, results in a weighted ex-vessel price of $1,382 per short ton, down 25 percent from 1981. Domestically caught, U.S. receipts of skipjack tuna generated about $98 million in ex-vessel revenues, 8 percent below 1981, at an average weighted price of $957 per short ton, down 7 percent from 1981. Receipts of U.S.-caught yellowfin tuna produced about $130 million in ex-vessel revenues, 8 percent below 1981, at an average weighted price of $1,117 per short ton, which is 6 percent below the 1981 average weighted price per ton.

Table 5.—U.S. cannery receipts[1] (short tons) of imported raw albacore, skipjack, and yellowfin (including bigeye and blackfin) tuna by landings site, 1981-82.

	Continental			Am. Samoa/Hawaii			Puerto Rico			Total		
Species	1981	1982	%[2]	1981	1982	%	1981	1982	%	1981	1982	%
Albacore	14,600	11,115	−23	28,643	22,814	−20	44,056	60,670	38	87,299	94,599	8
Skipjack	50,763	37,107	−26	21,424	8,729	−59	115,819	81,270	−30	188,006	127,106	−32
Yellowfin	19,348	8,171	−58	19,944	9,637	−51	44,295	32,941	−26	83,587	50,781	−39
Total	84,711	56,393	−34	70,010	41,180	−41	204,171	174,913	−14	358,892	272,486	−24

[1]Includes only imported tuna destined for U.S. canneries; excludes tuna imported as flakes, tuna not fit for human consumption, and "sushi" grade tuna. Source: NMFS Statistics and Market News, Southwest Region.
[2]A % symbol denotes the percent change between 1981 and 1982.

Table 6.—U.S. cannery receipts[1] (short tons) of imported raw tuna by species and ocean of origin, 1981-82.

	Albacore			Skipjack tuna			Yellowfin tuna[3]			Total		
Ocean	1981	1982	%[2]	1981	1982	%	1981	1982	%	1981	1982	%
E. Atlantic	17,105	19,816	16	67,011	49,417	−26	19,561	9,320	−52	103,677	78,553	−24
W. Atlantic	16,894	21,129	25	8,754	17,119	96	5,200	3,026	−42	30,848	41,274	34
E. Pacific	23	48	109	9,409	11,916	27	16,039	19,341	21	25,471	31,305	23
W. Pacific	47,608	36,760	−23	101,760	46,890	−54	42,477	18,321	−57	191,845	101,971	−47
Indian	5,669	16,846	191	1,072	1,764	65	310	773	149	7,057	19,383	175
Total	87,299	94,599	8	188,006	127,106	−32	83,587	50,781	−39	358,892	272,486	−24

[1]Includes only imported tuna destined for U.S. canneries; excludes tuna imported as flakes, tuna not fit for human consumption, and "sushi" grade tuna. Source: NMFS Statistics and Market News, Southwest Region.
[2]A % symbol denotes the percent change between 1981 and 1982.
[3]Also includes bigeye and blackfin tuna.

Preliminary U.S. Cannery Receipts of Imported Tuna

U.S. cannery receipts of imported[3] raw (whole and other than whole) tuna during 1982 are estimated to be 272,486 short tons, a decrease of 24 percent from 1981. Imports of albacore totaled 94,599 short tons in 1982, 8 percent above 1981, while imports of skipjack tuna (127,106 short tons) and yellowfin tuna (50,781 short tons) were both down from 1981, 32 and 39 percent, respectively (Table 5).

Of the estimated combined albacore and tropical raw tuna imports for 1982, 49 percent were from the Pacific Ocean, with the Atlantic Ocean and the Indian Ocean providing 44 and 7 percent, respectively, of the total. Forty-three percent of the total 1982 albacore imports were of Atlantic origin, with the Pacific and Indian Oceans contributing 39 and 18 percent, respectively. The Atlantic Ocean provided 52 percent of the total skipjack tuna imports in 1982, the Pacific Ocean provided 46 percent, and the Indian Ocean provided 2 percent. Seventy-four percent of the total yellowfin tuna imports came from the Pacific Ocean during 1982, with the Atlantic Ocean contributing 24 percent and the Indian Ocean 2 percent. Tuna imports from the western Atlantic, eastern Pacific, and Indian Ocean rose during 1982; there were substantial decreases in imports from the eastern Atlantic and western Pacific (Table 6).

Puerto Rico was the major receiving site for U.S. imported tuna in 1982, with about 174,913 short tons being received, or 64 percent of the total imports. Continental sites, with 56,393 short tons of tuna imports in 1982, accounted for 21 percent of the total; American Samoa/Hawaii, with 41,180 short tons of tuna imports in 1982, contributed the remaining 15 percent. A breakdown of 1982 raw tuna imports by species and receiving site is given in Table 5.

In 1982, Japan led all foreign countries in overall exports of raw tuna to the United States with an estimated 43,581 short tons, or 16 percent of the total tuna imports. Taiwan was the leading exporter of albacore to the United States during 1982 with 27,377 short tons, or 29 percent of the total albacore tuna imports. Japan exported more skipjack tuna to the United States in 1982 than any other single country, with 19,372 short tons, which represents 15 percent of the total. Panama led all countries in exports of yellowfin tuna to the United States in 1982 with 12,656 short tons, or 25 percent of the total. Preliminary 1982 U.S. raw tuna imports from the 20 leading exporting countries are presented in Table 7.

The value of imports received at U.S. canneries in 1982 approached $354 million, 26 percent below the corresponding value for 1981 ($479 million). Albacore, skipjack, and yellowfin tuna imports were valued at about $177 million, $116 million and $61 million, respectively, down 2, 42, and 38 percent, respectively, from 1981.

In terms of total cannery supply (domestically caught receipts plus im-

[3]Includes only imported tuna destined for U.S. canneries; excludes tuna imported as flakes, tuna not fit for human consumption, and "sushi" grade tuna.

Table 7.—Preliminary U.S. imports (short tons) of fresh, frozen, and partially processed whole tuna by exporting country for the 20 leading exporters during 1981-82. (Species totals do not agree with totals reported in Table 5 due to the presence of unidentified landings by country and the absence of foreign transshipments.)

Exporting Country	Albacore		Skipjack tuna		Yellowfin tuna		Not identified		Total		Percent change
	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	
Japan	16,474	21,263	33,091	19,372	4,352	2,891	40	55	53,957	43,581	−19
Taiwan	16,600	27,377	763	2,057	562	765	53	35	17,978	30,234	68
France	0	2,732	13,322	18,744	8,527	4,561	0	165	21,849	26,202	19
Panama	0	0	5,533	10,299	8,968	12,656	1,224	909	15,725	23,864	51
Brazil	123	608	6,754	14,509	36	415	0	2	6,913	15,534	124
Ghana	20	0	11,873	13,573	1,148	1,064	0	41	13,041	14,678	12
Venezuela	0	0	4,939	5,470	4,577	4,731	1,451	347	10,967	10,575	−3
Spain	473	532	9,439	8,274	3,552	1,203	4,011	256	17,475	10,265	−41
Cayman Islands	0	0	1,404	3,421	696	5,195	0	0	2,100	8,616	310
Philippines	101	359	14,855	5,424	11,045	2,071	7	1	26,008	7,855	−69
Rep. of South Africa	8,963	4,832	21	1,507	311	798	107	165	9,402	7,302	−22
Rep. of Korea	2,385	1,901	10,148	3,702	2,782	882	111	642	15,426	7,127	−53
Singapore	2,949	1,986	7,043	2,549	1,177	353	0	63	11,169	4,951	−55
Indonesia	22	0	5,594	3,900	244	389	25	0	5,885	4,289	−27
Trust Terr. Pacific	0	0	6,785	3,341	2,494	875	0	0	9,279	4,216	−54
New Zealand	2,136	2,584	1,150	641	0	0	0	2	3,286	3,227	−1
Fr. Indian Ocean	1,487	3,176	0	0	0	0	0	0	1,487	3,176	113
United Kingdom	0	0	0	1,874	0	894	0	0	0	2,768	100
South Asia	0	0	618	1,661	242	466	0	0	860	2,127	147
Mauritius	1,128	1,965	0	0	0	0	0	0	1,128	1,965	74
Other	32,681	24,187	50,891	5,314	31,191	9,983	194	448	114,857	39,934	−66
Total	85,542	93,502	184,223	125,632	81,904	50,192	7,223	3,160	358,892	272,486	−24

Source: U.S. Department of Commerce, Bureau of the Census.

ports) the United States is mainly dependent on tuna resources in the Pacific Ocean, which in 1982 accounted for about 72 percent of all U.S. tuna receipts; the Atlantic and Indian Oceans provided about 24 and 4 percent, respectively, of the 1982 total U.S. tuna receipts, virtually all imports. These proportions were not greatly different from 1981. However, as Tables 4 and 6 indicate, there were some significant shifts between 1981 and 1982 with respect to suboceanic area of origin and domestic or foreign source of supply. Of particular interest in this regard was the large increase in domestically caught receipts relative to the decline in imports from the western Pacific Ocean, as well as the increase in imports from the western Atlantic and Indian Oceans.

Table 8.—Estimated[1] U.S. canned production (thousands of standard cases) of white and light meat tuna, 1981-82.

Pack	Continental			Am. Samoa/Hawaii			Puerto Rico			Total		
	1981	1982	%[2]	1981	1982	%	1981	1982	%	1981	1982	%
White	1,532	1,022	−33	1,689	1,503	−11	2,605	3,487	33	5,826	6,012	3
Light	11,703	9,549	−18	3,721	2,971	−20	10,504	8,701	−17	25,928	21,221	−18
Total	13,235	10,571	−20	5,410	4,474	−17	13,109	12,188	−7	31,754	27,233	−14

[1]Derived from estimated proportions of the total 1981 and 1982 white and light meat packs at individual canning sites applied to total white and light meat packs reported in USDC (1983).
[2]A % symbol denotes the percent change between 1981 and 1982.

Production of Canned Tuna for Human Consumption

Domestic Production

Tuna canned for human consumption in the United States consists of white meat or albacore and light meat tuna, a blend of the tropical species, packed in either oil or water. Both light and white meat tuna are canned in either the solid, chunk, or grated form.

Of the three major canned tuna production centers, Puerto Rico was the leading U.S. processing site during 1982, accounting for 45 percent of the combined light and white meat pack. Puerto Rico-based processors led in the production of white meat in 1982 with 58 percent of the total, followed by American Samoa/Hawaii with 25 percent. Continental processors had the largest share of light meat production in 1982, 45 percent; Puerto Rico followed with 41 percent. Except for the increase in white meat production at Puerto Rico during 1982, white and light meat production in all areas was down from 1981. Table 8 presents estimates of the 1981 and 1982 white and light meat production at major canning sites in thousands of standard cases[4].

Imports

Imports of canned tuna in 1982 to-

[4]A standard case consists of 48 6.5-ounce cans for chunk-style pack, 48 7-ounce cans for solid pack, and 48 6-ounce cans for grated.

taled approximately 4,496,000 standard cases (based on 19.5 pounds to the standard case), an increase of 26 percent from 1981. Imports of canned white meat tuna amounted to 572,000 standard cases, a 4 percent decrease from 1981, while approximately 3,912,000 standard cases of light meat tuna were imported in 1982, up 32 percent from 1981.

The Philippines was the leading exporter of canned tuna to the United States in 1982 with 1,417,000 standard cases, all light meat, or 32 percent of the 1982 total. Japan was the foremost exporter of canned white meat tuna, accounting for 372,000 standard cases, representing 65 percent of the total U.S. canned white meat imports for 1982. The imports of canned light meat tuna from the Philippines in 1982 represented 36 percent of the total canned light meat imports. Estimates of 1982 canned tuna imports by exporting country are given in Table 9.

Table 9.—Preliminary U.S. imports (thousands of standard cases) of canned tuna by exporting country, 1981-82.

Exporting country	Albacore (not in oil)		Light meat (not in oil)		Not identified (in oil)		Total		Percent change
	1981	1982	1981	1982	1981	1982	1981	1982	
Australia	0	0	3	99	0	0	3	99	3,200
Azores	0	0	0	0	3	2	3	2	-33
France	0	0	0	0	1	0	1	0	-100
Hong Kong	0	0	3	4	0	0	3	4	33
Indonesia	0	0	7	30	0	0	7	30	328
Italy	0	0	0	0	1	1	1	1	0
Japan	368	372	689	955	0	0	1,057	1,327	25
Macao	0	0	0	1	0	0	0	1	100
Malaysia	18	23	16	14	0	0	34	37	8
Peru	0	0	3	0	0	0	3	0	-100
Philippines	13	0	1,084	1,417	0	0	1,097	1,417	29
Portugal	1	0	0	1	0	2	1	3	200
Rep. of Korea	0	2	2	1	0	0	2	3	50
South Asia	0	0	30	17	0	0	30	17	-43
Singapore	0	0	3	6	0	0	3	6	100
Spain	0	0	0	0	9	6	9	6	-33
Taiwan	195	166	597	417	0	0	792	583	-26
Thailand	1	8	526	950	0	1	527	959	81
Trinidad	0	0	2	0	0	0	2	0	-100
West Africa	0	1	0	0	0	0	0	1	100
Total	596	572	2,965	3,912	14	12	3,575	4,496	26

Source: U.S. Department of Commerce, Bureau of the Census.

U.S. production of canned tuna in 1982 was valued at $885 million, down nearly 25 percent from 1981. Based upon total light and white meat volume, this results in a weighted average standard case price of $32.49 for 1982, compared with $37.17 for 1981, a 13 percent decrease. The value of imported canned tuna was $113 million in 1982, a 2 percent increase from 1981, this despite a 19 percent decrease in the weighted average price of imported canned tuna (white and light combined) from $30.87 to $25.13 per standard case.

Table 10.—Estimated impacts of tuna harvesting on the California economy.

Item	Tropical tuna			Albacore		
	Economic production ($)	Household income ($)	Employment (full-time jobs)	Economic production ($)	Household income ($)	Employment (full-time jobs)
A. Per $1,000 of lost tuna landings (before processing).						
Direct	-1,000	-611	-0.006	-1,000	-438	-0.076
Direct and indirect	-1,514	-751	-0.012	-1,720	-641	-0.085
Direct, indirect, and induced	-3,663	-1,042	-0.028	-3,554	-890	-0.098
B. Given the decline in domestically caught cannery receipts at continental sites, 1981-82.						
Direct	-14,000,000	-8,554,000	-84	-13,000,000	-5,694,800	-988
Direct and indirect	-21,196,000	-10,514,880	-168	-22,360,000	-8,333,000	-1,105
Direct, indirect, and induced	-51,282,000	-14,588,000	-392	46,202,000	-11,570,000	-1,274

Economic Impacts

The following discussion attempts to assess the economic impact of the U.S. tuna industry decline during 1982 using results from an input-output study of California fisheries conducted by King and Shellhammer (1982). These investigators derived California economic impact multipliers for tuna purse seiners (which accounted for almost all of the U.S.-caught tropical tuna receipts in 1982), salmon/albacore vessels, and tuna processors based in California. Their findings indicate that every $1,000 of California tropical tuna cannery receipts supplied by California-based purse seiners generates about $3,633 in California production activity, $1,042 in household income, and 0.028 full-time jobs. For each $1,000 of California albacore cannery receipts supplied by California-based salmon/albacore vessels, California production activity increased by $3,554, household income increases $890, and about 0.098 full-time jobs are created. The overall impact on the California economy of a $1,000 change in ex-vessel albacore or tropical tuna sales is shown in Table 10A, broken down according to direct economic activity, indirect economic activity (generated through purchases of goods and services by the tuna harvesting sector), and induced economic activity (generated by the expenditures of firms and

households with respect to the income they derive from the sale of goods and services to the harvesting sector).

Based on the decline in continental tropical tuna receipts from the California-based purse seine fleet between 1981 and 1982 (13,134 short tons from Table 3), and corresponding price conditions, ex-vessel sales revenue is estimated to have decreased by $14 million. Using the multipliers from King and Shellhammer (1982), the predicted impact of this decline on the California economy is shown in Table 10B[5]. The decrease in albacore cannery receipts from California-based vessels at continental sites during 1982 (9,396 short tons from Table 3) resulted in ex-vessel albacore tuna revenues falling an estimated $13 million. The predicted impact of the reduced 1982 albacore cannery receipts on the California economy is also shown in Table 10B. The combined decline in albacore and tropical tuna receipts between 1981 and 1982 translates into a direct harvesting-related production decline of about $27 million, a direct decrease in household income of about $14 million and a predicted loss of the equivalent of more than 1,000 full-time jobs[6]. While corresponding economic multipliers for American Samoa/Hawaii and Puerto Rico are not available, the situation in these areas for 1982 may not be as great as projected for the continental U.S. Domestically caught cannery receipts at these sites increased in 1982, but are smaller that those for the continent, and are relatively less important as a source of raw material to processors and as a source of local income and employment.

The King and Shellhammer (1982) study also derived economic impact multipliers for the processing sector of the California-based segment of the U.S. tuna industry (Table 11A). These multipliers, as in the case of cannery receipts of raw tuna, can be used to assess the impact of reduced processing at continental canneries on the California economy. Production of both white and light meat tuna at California canneries fell by a reported 2.66 million standard cases between 1981 and 1982 (Table 8). At a weighted average price of $32.49 per standard case, this amounts to a decrease of about $87 million in white and light meat production. The direct impact of this decline on the California economy, as predicted in Table 11B, is a reduction of about $14 million in household income and a loss of the equivalent of 870 full-time jobs. Again, multipliers for American Samoa/Hawaii and Puerto Rico are not available to assess the regional impacts of changes in canned tuna production in these areas, although lesser impacts are implied by the smaller declines in pack (Table 8).

The multiplier analysis suggests a substantial impact on the California economy due to reduced activity in the California-based segment of the U.S. tuna industry. When the predicted impacts of reduced domestically caught U.S. tuna receipts, imports, and associated canned production are combined, there is a direct loss of $114 million in revenues generated by harvesting and processing activity. This translates into a reduction in employment equal to about 1,900 full-time jobs in the harvesting and processing sectors of the California-based segment of the U.S. tuna industry, with a corresponding loss in household income of nearly $29 million. The overall predicted impact, which also includes indirect and induced effects, is a loss of almost $320 million in California production activity, a decrease of $71 million in household income, and a loss of the equivalent of about 3,100 full-time jobs[7].

Table 11.—Estimated impacts of tuna processing on the California economy.

Item	Economic production ($)	Household income ($)	Employment (full-time jobs)
A. Per $1,000 of lost canned tuna production revenues.			
Direct	−1,000	−161	−0.010
Direct and indirect	−1,984	−591	−0.023
Direct, indirect, and induced	−3,674	−820	−0.036
B. Given the decline in U.S. tuna processing at continental sites, 1981-82.			
Direct	− 87,000,000	−14,007,000	− 870
Direct and indirect	−172,608,000	−51,417,000	−2,001
Direct, indirect, and induced	−319,638,000	−71,340,000	−3,132

Acknowledgments

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[5]The multiplier analysis as applied here assumes fixed ratios of inputs to outputs. A problem of overestimating expenditure/employment impacts arises under these conditions if, for example, there is a decrease in catch per unit effort of California purse seiners after the multipliers are derived, i.e., a lower level of output associated with the same level of inputs.

[6]The use of full-time job equivalents suggests that the contraction in labor input could have been accomplished through temporary layoffs and reduced hours of plant operation, not necessarily in this number of people actually losing jobs.

[7]These figures are found in the bottom row of Table 11B which shows the combined direct, indirect, and induced impacts of reduced processing activity. Since indirect processing impacts reflect backward linkages to the harvesting sector, the overall impact of tuna processing activities in California will incorporate those for harvesting.

Oceanographic Observations Off the Pacific Northwest Following the 1982 El Niño Event

R. K. REED

ABSTRACT—The evolution of sea surface temperature anomalies off the Pacific Northwest during the 1982-83 El Niño seems to be in general agreement with their formation through poleward advection by a long wave. Oceanographic observations in May 1983 indicated significant positive thermal anomalies above 500 m; salinity anomalies showed a reversal in sign which implied both sinking of upper water and northward advection. Geostrophic flow along 47°N revealed no evidence of the California Undercurrent.

Introduction

In early 1983 a series of meetings was held by managers and researchers of the National Marine Fisheries Service (NMFS), Pacific Marine Environmental Laboratory (PMEL), and University of Washington. These discussions were prompted by the realization that the ocean off Oregon and Washington had warmed appreciably following the El Niño event that reached the eastern tropical Pacific in fall 1982. A consensus emerged from the discussions that special efforts should be made to obtain oceanographic observations off Oregon and Washington during the warm event, which was expected to affect various fisheries. Consequently, additional observations were planned for a cruise of a fishery research vessel of the Soviet Union in April-May, and PMEL researchers agreed to make extra measurements on cruises of the NOAA ship *Discoverer*. These data, plus routine sea surface temperature information, have been used in an effort to provide a timely description of the warming off the Pacific Northwest. Additional studies will also include previous events, and impacts on the biota will be examined.

Background

It is now clear that El Niño events in the equatorial Pacific are frequently accompanied by significant warming and rising sea level over a vast area of the Pacific (Enfield and Allen, 1980; Chelton and Davis, 1982). These sporadic changes are thought to be at least partially the result of equatorially trapped long waves which initiate the warming in the eastern tropical Pacific and then propagate poleward as coastally trapped waves (Wyrtki, 1975; McCreary, 1976). However, all anomalous temperature events along the west coast of North America do not appear to be caused by this process, and large-scale variations in wind forcing may also be important (Chelton and Davis, 1982).

The El Niño events do produce striking visual coherence in sea level and temperature records (Enfield and Allen, 1980); however, considerable variation in these effects seems to exist, which is not obviously related to the magnitude of warming in the eastern tropical Pacific. For example, the 1972 El Niño appeared to affect tropical sea level at least as much as did the 1957-58 event, but the 1972 El Niño was not apparent north of California, whereas sea level rose in a dramatic and coherent manner in early 1958 as far north as Yakutat, Alaska. Although a complete set of sea level data for the 1982 El Niño is not yet available, initial impressions are that the present El Niño is certainly a major one (Wooster, 1983), and the temperature anomalies in the tropics and along the west coast of North America are readily apparent.

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Surface Temperature Anomalies

A time series of coastal sea surface temperature anomalies (from the long-term monthly means; taken from NOAA's *Oceanographic Monthly Summary*) is shown for July 1982-June 1983 in Figure 1. The maximum averaged anomalies were 1.6°-1.7°C for the three sites shown, but all locations had negative values prior to the warming. At lat. 35° and 41°N maximum anomalies occurred in January-February 1983, but at lat. 47°N the anomalies increased until April 1983. By June 1983, the anomalies at all sites had decreased significantly.

Preliminary results indicate that the maximum rate of warming off Peru probably occurred in early October 1982 (Wyrtki, 1983). From the theory of internal Kelvin waves and evidence from sea level data, Enfield and Allen (1980) suggested a phase speed of roughly 100 km/day; consequently one might expect to see the maximum change in anomaly off Oregon-Washington about 2 months after the wave reached Peru. None of the plots in Figure 1 are in exact agreement with this figure; large rates of warming did

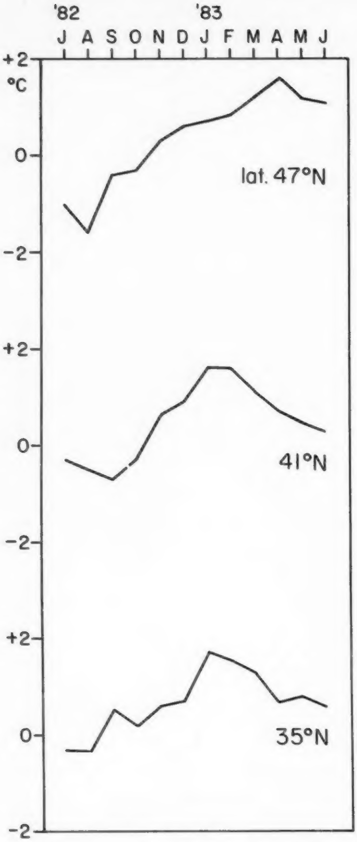

Figure 1.—Time series of monthly mean, spatially averaged, sea surface temperature anomalies (from the long-term monthly means) between the Pacific Northwest coast and long. 125°W at lat. 35°N and between the coast and long. 127°W at lat. 41° and 47°N.

occur at lat. 35° and 41°N during December-January, which suggests a travel time of 3 months, but the increase at lat. 47°N was quite gradual. Figure 2 shows a time plot of the latitude of the northern boundary of the coastal positive anomaly. It shows rapid rates of movement of the anomaly during October-November and again in December-January; however, a peculiar lack of movement was present during November-December. It should be

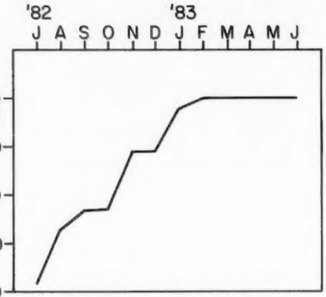

Figure 2.—Time progression of the latitude of the northern edge of the positive sea surface temperature anomaly.

stressed that these data (from ships-of-opportunity and buoys) are not highly accurate, and the anomalies can vary as a result of air-sea energy exchange or upwelling that is different from the climatological mean. Thus it would be surprising if the results were entirely consistent with only an advective process.

The increase in positive surface temperature anomaly which apparently reached a peak off the Pacific Northwest during February-April continued northward into the Gulf of Alaska and then westward to the Bering Sea and Aleutian Islands. An examination of the anomaly maps (*Oceanographic Monthly Summary*), however, argues against the cause of this warming being solely an extension of the long wave off our west coast. In fact, the movement of anomalies into the Bering Sea seems to be mainly from the west; by November 1982 a vast area in the northwest Pacific (including Japan and the Kamchatka Peninsula) was abnormally warm, and by December this pattern seems to have spread eastward into the central Bering Sea somewhat before warming from the southeast occurred. Also, the maximum values in the Bering Sea were slightly greater than those off the Pacific Northwest. Blaha and Reed (1982) concluded that the equatorial Kelvin waves associated with Los Niños did not penetrate poleward into

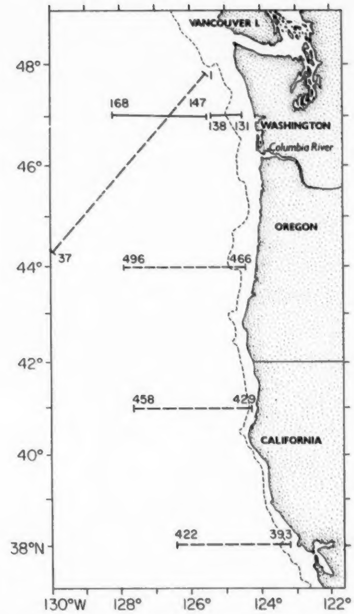

Figure 3.—Location of XBT sections (dashed lines) and a CTD section (solid lines) obtained by the NOAA ship *Discoverer*, 15 May-3 June 1983.

mid-latitudes along the western margin of the Pacific. Thus the large-scale warming in the northwest Pacific must result from a different mechanism than that along the eastern margin of the ocean.

Subsurface Conditions

NOAA Data

The principal observations made by the NOAA ship *Discoverer* in May-June 1983 are shown in Figure 3. These closely spaced XBT (expendable bathythermograph) drops and CTD (conductivity/temperature/depth) casts can be used to infer several features of the subsurface thermohaline properties as well as baroclinic flow. The XBT sections at lat. 38°, 41°, and 44°N are presented in Figure 4. The only indication of active coastal upwelling was on the section at lat. 41°N where the

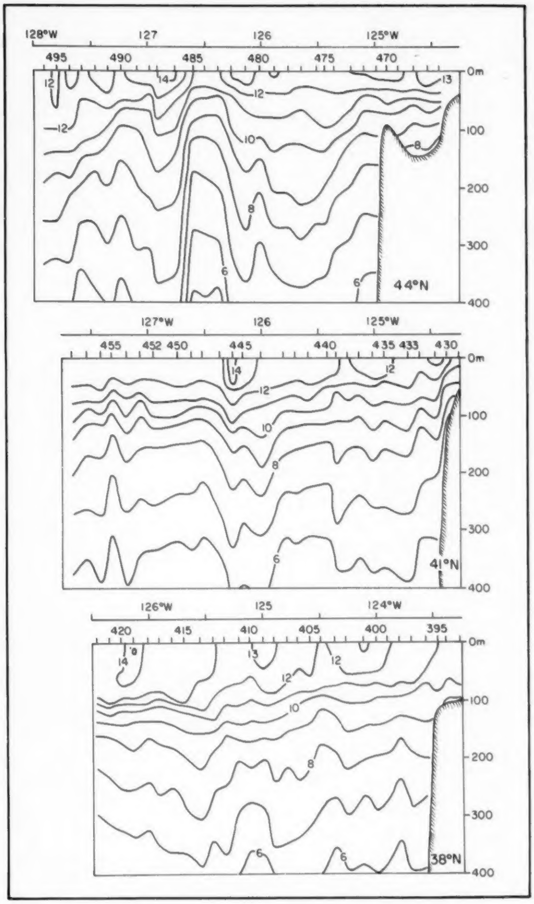

Figure 4.—Vertical XBT sections of temperature (°C) at lat. 38°N (15-16 May 1983), lat. 41°N (16-17 May 1983), and lat. 44°N (18 May 1983).

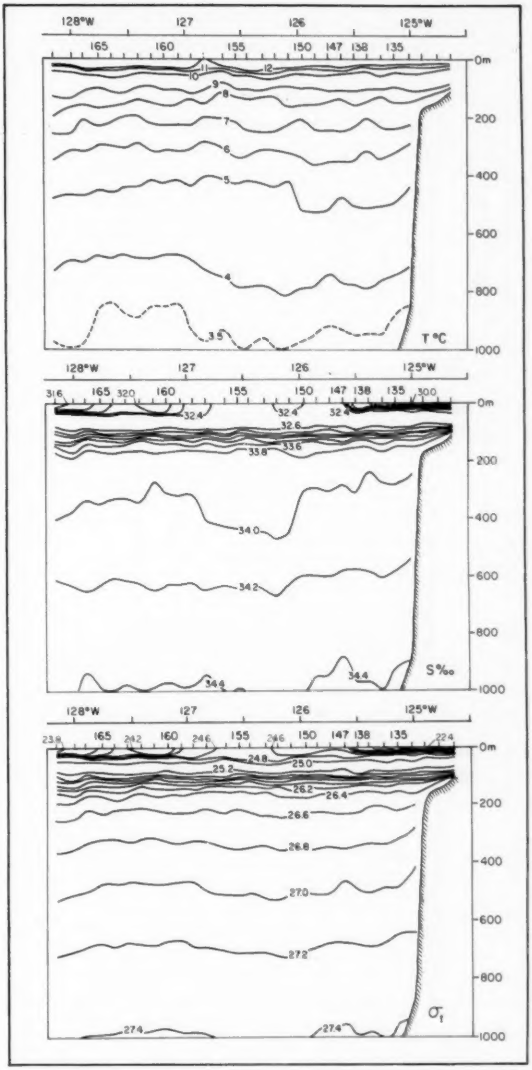

Figure 5.—Vertical CTD sections of temperature (°C), salinity (‰), and sigma-*t* density along lat. 47°N, 19-22 May 1983.

isotherms inshore of station 433 slope steeply upward. Elsewhere, this section suggests weak southward flow (isotherms tilted up to the east) east of long. 126°W, with a zone of northward flow between long. 126.0° and 126.5°W. The lat. 38°N section implies mainly southward flow except west of long. 125.5°W. At lat. 44°N the thermal structure was quite complex; the large domelike feature between stations 481 and 486 may be a counterclockwise eddy. Elsewhere the data suggest more intense baroclinic structure than at the other sites along the coast. In general, the isothermal slopes are quite coherent vertically, which implies the lack of any major counterflows below the surface.

Vertical sections of temperature, salinity, and sigma-*t* density (density minus one times 10^3) for the CTD line along lat. 47°N are shown in Figure 5. It is apparent that salinity slopes are quite important to the density structure in these subarctic waters (Dodimead et

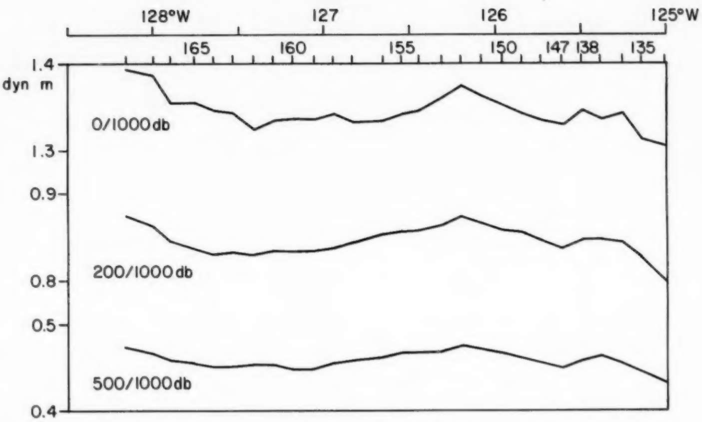

Figure 6.—Variation of geopotential anomaly (dyn m) of the 0-, 200-, and 500-db surfaces, referred to 1,000 db, along lat. 47°N, 19-22 May 1983.

al., 1963); farther south, thermal effects begin to dominate the baroclinic structure. The sigma-*t* slopes are vertically coherent and suggest alternating zones of southward, northward, and southward flow proceeding offshore.

Figure 6 shows the geopotential anomalies of the 0-, 200-, and 500-db (decibars pressure; 1 db ≅ 1 m) surfaces, all referred to 1,000 db (maximum cast depth). The slopes of the surfaces are proportional to geostrophic flow, with line segments sloping downward to the east representing southward flow. The greatest computed speed (35 cm/second) was for the 0/1,000-db surface between stations 166 and 167; speeds elsewhere were generally much less than this. Although the 1,000-db surface may not be entirely level, the amount of baroclinic structure below this level off the Pacific Northwest is quite small (Reid and Arthur, 1975; Reed and Halpern, 1976). Ignoring small-scale features, the surface circulation consisted of southward flow between stations 134 and 152, northward flow from station 152 to 162, and southward flow west of station 162. Although this was suggested by the sigma-*t* section, Figure 6 presents striking evidence that the flow was vertically coherent. There is simply no evidence for any subsurface counterflow or undercurrent, and the only suggestion of any northward flow along the continental slope is a 9 km band rather far offshore between stations 138 and 147.

Thus the California Undercurrent normally present along the slope (Hickey, 1979) was absent in mid-May 1983. Ingraham (1967) presented data for May 1963 which also showed flow that was generally vertically coherent, but the nearshore flow was more northerly than across the section here. Data are simply inadequate to indicate if the undercurrent may typically be absent in spring (Hickey, 1979). If the warm water was advected into this region by a long, coastally trapped wave (with a strong current pulse) a few months before this cruise, there would not necessarily be any evidence for it in these data. Intuitively, however, one might have expected some intensification of the California Undercurrent, but such does not appear to be the case.

The CTD section at lat. 47°N is quite close to one (at lat. 47.5°N) in September 1973 from which Reed and Halpern (1976) derived the percentage of Pacific Equatorial water, using temperature-salinity curves, as an index in examining the California Undercurrent. September 1973 was a period with essentially normal sea level and coastal water temperatures off Washington (Enfield and Allen, 1980). At levels of 200-300 m the percentage of equatorial water in May 1983 was about 40 percent, rather than roughly 30 percent in September 1973; however, below this level the differences were smaller and less systematic. The equivalent thickness (integral of the area under a depth-percentage curve) of the equatorial water from 200 to 1,000 m, however, was only 4 percent greater in May 1983 than the value in September 1973. This analysis suggests that the water properties associated with the 1982 El Niño in the upper 300 m were more characteristic of equatorial water than in a normal year, but that they differed little below this level.

Perhaps a more straightforward comparison is to derive temperature differences at specific depths between data on the section at lat. 47°N and stations at the same longitude at lat. 47.1°N in September 1973 (Holbrook, 1975). The mean results, based on a comparison at six stations, are given in Figure 7. At 100 m the water in spring 1983 was 1.6°C warmer than in fall 1973; at 200, 300, 500, and 1,000 m the differences were +0.6°, +0.4°, +0.1°, and −0.1°C, respectively. The standard deviations from the means in this data set are relatively small. In May the sea surface anomaly was +1.2°C (Fig. 1), slightly less than the difference at 100 m. Comparable differences in salinity varied from −0.39‰ at 100 m to slightly positive at 300 m and below; only the differences at 100 and 300 m were statistically significant from zero, however. The negative salinity difference at 100 m, which is also present but much smaller in the Soviet data discussed below, suggests that the upper part of the water column had been depressed, perhaps through downwelling associated with the long wave, whereas the positive differences below are in agreement with northward advection of equatorial water.

Soviet Data

A fishery vessel of the Soviet Union has conducted resource surveys in cooperation with the NMFS Northwest and Alaska Fisheries Center (NWAFC) during April-June in each of the last 4

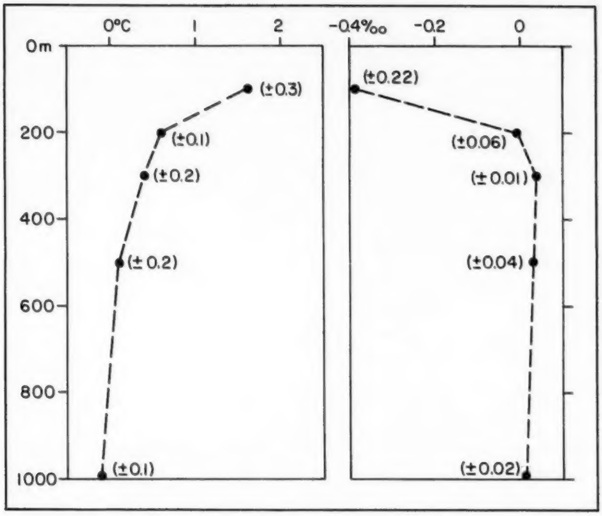

Figure 7.—Vertical structure of the differences in temperature and salinity between 19-21 May 1983 (along lat. 47.0°N) and 20 September 1973 (along lat. 47.1°N). Values in parentheses indicate the standard deviations from the mean differences.

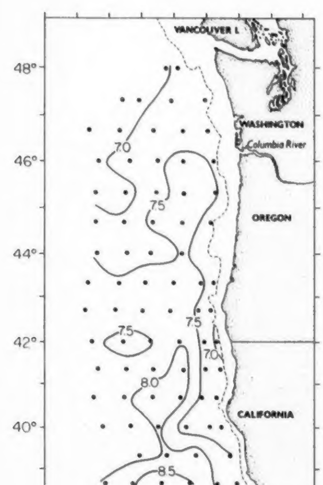

Figure 8.—Distribution of mean temperature (°C) at 200 m from Soviet cruises during April-May 1980, May-June 1981, and May-June 1982.

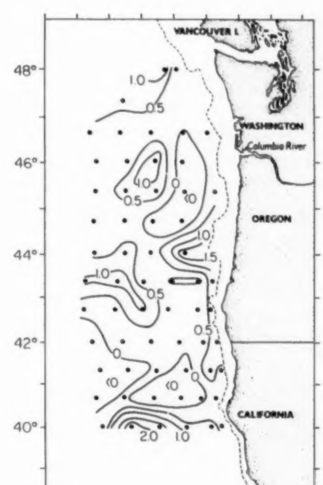

Figure 9.—Differences of temperature (°C) at 200 m during April-May 1983 from the mean temperatures at the same sites during April-June 1980-1982.

years. The area surveyed has been from lat. 38° to 48°N and from the coast to about long. 128°W. Oceanographic observations consisted of Nansen bottle casts to 500 m with bottles at traditional standard depths. The manuscript data were keypunched, and values were interpolated to standard depths under supervision of NWAFC personnel. The stations are rather widely spaced and are too shallow for reliable derivation of geostrophic flow. In addition, the salinity data appear to be of marginal quality, although they are useable for some purposes. On the other hand, the data set is quite nice in that essentially the same stations have been occupied for 4 years, and one can compare conditions during the present El Niño with "normal" conditions from the three previous years.

Temperature and salinity data at various levels for spring 1980, 1981, and 1982 were averaged, and the distributions were mapped. Figure 8 presents the averaged temperature at 200 m, which is in good general agreement with the distribution from long-term mean data in Favorite et al. (1976). The fact that the maximum temperatures are located some distance offshore probably reflects the normal coastal upwelling; the distribution at 500 m (not shown) shows the warmest water along the inner part of the continental slope. Figure 9 shows temperature differences at 200 m during April-May 1983 compared with the data in Figure 8. There is considerable variability over fairly small spatial scales, which might result from eddies or oscillations caused by internal waves. The water was generally warmer in spring 1983 than spring 1980-82, however, and there is a consistent band of higher temperatures along a portion of the continental slope. The differences have a mean value of +0.4°C, which is similar to the value at lat. 47°N (+0.6°C; Fig. 7), but the standard deviation in this data set (±0.56°C) is over four times larger than the value at lat. 47°N. The mean value of the temperature difference at 500 m is +0.1°C; the values north of lat. 43°N, however, average +0.2°C, while those to the south have a mean of zero. The salinity differences at 200 and 500 m average −0.03 and

−0.01‰, respectively, but only the first value is statistically significant from zero. The Soviet data do indicate warmer than normal temperatures during the El Niño at 200 m, while a spatial difference at 500 m was suggested.

Discussion

The 1982 El Niño appears to have produced significant warming at high latitudes much like the event of 1957-58. However, the phase of the recent El Niño appears to be 2-3 months before that of the earlier, typical one, both in the tropics and to the north. The effect of this difference should be to produce maximum anomalies before the maximum seasonal rate of heating; thus absolute maximum temperatures, as opposed to maximum anomalies, might be somewhat less than during a more typical event. One can speculate, then, that the recent El Niño should have had less severe effects on the biota, at least in terms of the temperature tolerance of organisms, than events of comparable magnitude but more typical timing. However, this aspect of the problem will require a comprehensive examination of biological and fisheries data.

Evolution of the thermal anomalies and their apparent northward movement with time are at least suggestive of an advective process caused by a coastally trapped long wave. The data also appear to roughly agree with the expected phase speeds. On the other hand, the zone of warm water off the Pacific Northwest was several times wider than the Rossby deformation radius. Also, warming in the Bering Sea appears to have resulted from eastward movement of warm water in the northwest Pacific; this suggests some aspect of wind forcing there, rather than effects from long-wave propagation. The geostrophic flow across a section off Washington did not reveal any subsurface northward undercurrent; it is not known if its absence was a normal seasonal feature or was related to the El Niño or some other event.

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I appreciate comments by the NOAA ad hoc group on El Niño effects, especially those of M. Hayes and D. Fluharty. A. Kendall of the Northwest and Alaska Fisheries Center provided considerable assistance in obtaining the Soviet data in a useable form. Observations aboard the NOAA ship *Discoverer* were arranged and obtained by J. Cline, R. Feely, and T. Bates of PMEL. P. Pullen and S. Wright of PMEL assisted in data preparation.

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Ciguatera in the Eastern Caribbean

DAVID A. OLSEN, DAVID W. NELLIS, and RICHARD S. WOOD

Introduction

Ciguateric fish poisoning is a disease of circumtropical distribution which has apparently been a feature of human use of Caribbean marine resources since pre-Columbian times (Price, 1966). Resource use patterns by the Carib and Arawak Indians who inhabited the eastern Caribbean would indicate that they, too, must have encountered ciguateric problems (Price, 1966).

Presently, many of the Lesser Antillean islands have ended or are ending their colonial ties and have assumed the economic responsibilities of independent nationhood. Many of these new Caribbean island nations are among the most densely populated areas in the world, with several (most notably Barbados) among the top ten in world population density. As part of their continuing political and economic evolution, emphasis is being placed upon economic development of the limited resources available.

Fish have traditionally been a primary source of protein for island residents, a fact which has resulted in a high demand for them and heightened the impact of ciguatera within the communities. Fisheries development is a frequent and important strategy for the region since primary production of marine protein both enhances the local diet and eliminates the need to import expensive substitutes, which may exacerbate serious balance-of-payment deficits that normally characterize small-island economies.

There are two features of fishery resources in the eastern Caribbean which override the best intentioned plans for development. The first of these is the inability of the resources to support the additional levels of exploitation implied by most projected development schemes. Many island platforms are simply too small to support additional exploitation, and development must concentrate upon optimization of resource utilization and distribution. Evidence to this effect is presented subsequently.

The second feature limiting Caribbean fishery development is tropical fish poisoning, which affects and limits every serious or responsible attempt to develop fisheries in areas where ciguatera occurs. Ciguatera problems may range from the unquantifiable loss of productivity of poisoned workers to lack of product export and public health problems stemming from insufficient protein in the diet.

Tacket[1] estimated that the annual incidence of fish poisonings reported to the emergency room in St. Thomas, V.I., was around 4.2 cases per thousand population. In a household survey, she reported a level of 7.3 per thousand, indicating that 43 percent of the cases are not reported to the emergency room. McMillan et al. (1980) found in their household survey that only 45 percent of those poisoned reported to the emergency room. They also found that 22 percent of all households surveyed experienced at least one poisoning in 5 years. Taylor (cited by Tacket, footnote 1) reported that this figure was as high as 31 percent in homes where fish was eaten. In this regard, St. Thomas is probably typical of other islands where ciguatera is a normal risk associated with the consumption of marine protein.

Ciguatera poisoning is not only frequent but dangerous: Scheuer[2] has reported that ciguatoxin is possibly the fifth most toxic chemical compound

ABSTRACT—Ciguatera fish poisoning plays an important role in Caribbean marine resource development. Many independent eastern Caribbean island nations rely heavily on marine protein. Current demand in these areas for seafood approaches 775,000 t, a figure greatly in excess of the 200,000 t potential yield, as well as current landings which are near 87,000 t.

Annual incidence of ciguatera fish poisoning may reach nine per thousand residents in Caribbean communities like St. Thomas, U.S. Virgin Islands. These high rates affect public health, fishery development, and liability aspects of island life. Distribution of ciguatera in the Caribbean indicates that it is found most frequently north of Martinique. Three areas of "high risk," as well as "high risk" species, are identified. In St. Thomas nearly 50 percent of the 84 species in the catch and 56 percent of the total landings by weight bear some risk of intoxication if eaten.

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[1]Tacket, C. 1981. Studies of epidemiological and clinical aspects of ciguatera. Presentation at Ciguatera Conference, San Juan, Puerto Rico, unpubl.

[2]Scheuer, P. 1981. Chemistry of ciguatoxin. Presentation at Ciguatera Conference, San Juan, Puerto Rico, unpubl.

known. The minimum lethal dose in mice is 45×10^{-8}g/kg.

Since most fishery development attempts involve capitalization of centralized marketing mechanisms, liability associated with the sale of ciguatoxic fish also becomes an issue. In the Virgin Islands, fish has traditionally been marketed by the fishermen themselves, and resolution of the liability question has been accomplished through personal interaction. As marketing has evolved through the establishment of cooperatives and fish markets, resolution of liability conflicts associated with fish poisoning has been through the courts. Currently, fish markets in the Virgin Islands carry expensive product liability insurance which requires the posting of warnings that "purchase of local fish may be hazardous to the customer's health." All of these costs are, of course, passed on to the consumer. Several St. Thomas markets no longer sell local fish and import all fish products sold, except for a very narrow range of species caught from specific "safe" locales by fishermen who have developed reputations for product reliability.

Ciguatera impacts can also be felt in the tourist industry. The diversity and novelty of local fishes frequently attract tourists. Many hotels, however, refuse to risk preparing locally caught fish since poison victims may sue for damages or, at best, make bad publicity.

Although these impacts are difficult to assess, we attempt to do so here. To relate them to the utilization of eastern Caribbean fishery resources, this discussion will deal with the region's demand for and ability to produce marine protein. We also analyze the incidence and risk of fish poisoning in the Virgin Islands, which is more or less typical in species composition to many of the small islands in the eastern Caribbean. Finally, we present some of the characteristics common to ciguatoxic fish which are used by the knowledgeable fish buyer to reduce the risk associated with consumption of locally caught fish. Eastern Caribbean seafood consumers have acquired a considerable body of local knowledge which they employ in order to avoid intoxication.

Table 1.—Caribbean island fisheries background data.

Island/nation	Land area[1] (km²)	Shelf area[2] (km²)	Population	Number of tourists[4]	Fish landings[5] (t)	
Bahamas	13,935	195,000	210,000	118,596	2,800	(Nassau only)
Hispaniola						
Dominican Republic	48,734	1,350	5,275,410	301,178	6,435	
Haiti	27,750	N/A	4,832,504	139,964	2,500	
Jamaica	11,430	3,250	2,137,300	395,382	10,100	
Cuba	114,524	40,000	9,533,000	N/A	165,000	
Bermuda	54	518	60,000	N/A	468	(shellfish only)
Turks and Caicos	430	1,200	7,615	12,005	1,050	
Puerto Rico	8,897	3,990	3,187,600	1,698,481	1,819	
U.S. Virgin Islands	449	1,972	95,000	1,200,000	1,272	
British Virgin Islands	202	4,579	12,574	120,054	692	
Anguilla	120	[3]4,493	8,615	7,422	760	
St. Martin	34	[3]4,493	25,598	221,544	1,000	
St. Barthelemy	N/A	[3]4,493	5,000	N/A	N/A	
Saba	13	4,198	1,018	N/A	[6]40	
St. Christopher-Nevis	261	[3]882	47,481	32,437	27	
St. Eustatius	261	[3]882	1,342	N/A	40	
Antigua-Barbuda	441	2,533	78,000	86,627	800	
Montserrat	98	140	14,160	15,537	126	
Guadeloupe	1,760	1,884	324,530	118,078	4,990	
Dominica	751	470	70,302	13,651	500	
Martinique	1,100	1,273	324,832	158,375	2,167	
St. Lucia	616	545	109,928	90,070	2,200	
Barbados	430	320	251,272	369,924	1,579	
St. Vincent and Grenadines	389	1,300	101,000	38,448	379	
Grenada	344	2,000	111,184	29,389	900	
Aruba	193	206	159,067	188,831	[6]700	
Curacao	444	96	63,049	68,457	[6]850	
Bonaire	288	82	9,034	22,746	[6]100	
Trinidad and Tobago	5,218	20,400	1,162,000	194,898	4,322	
Cayman Islands	259	250	11,000	120,263	N/A	

[1]Europa Publications (1980).
[2]Manar (1974).
[3]Shared jurisdiction, boundaries undeclared.
[4]Caribbean Tourism Research and Development Centre, 1981 (1980 figure).
[5]FAO Fish. Rep. 278, supplement.
[6]G. van Buurt, Netherlands Antilles Department of Agriculture and Fisheries. Pers. commun., 1982.

Eastern Caribbean Fisheries

The 31 island nations of the Antilles chain are located on 29 different island platforms. In addition, outlying submerged banks contribute an additional area for a total of around 300,000 km² of fishable shelf. Although some island nations (most notably Barbados) have succeeded in harvesting significant quantities of pelagic species, most of the fish harvest depends on the island platform for its production.

Fishery officials have estimated that the sustainable yield in the Caribbean is 0.64 t/km² (CFMC[3]). Using this figure, fish production of the submerged platforms can then be calculated by multiplying the shelf area times the production constant. The assumption is made that sustainable yield levels cannot be exceeded without long-term reduction of the resource's ability to replenish itself. In fact, however, some eastern Caribbean fisheries resources are harvested in excess of sustainable yield. Long-term implications of this strategy are presently unknown. The results presented in Table 1 indicate that the total potential annual fish production which may be expected in the Caribbean islands is slightly under 200,000 t.

In Table 2 we have estimated the demand for marine protein as determined from population estimates and per capita seafood consumption figures from the literature. Total annual demand for seafood consumed in the Antilles is near 775,000 t, over three

[3]CFMC. 1981. Fishery management plan for shallow water reef fishes. Unpubl. rep., 47 p., on file with the Caribbean Fishery Management Council.

Table 2.—Demand for marine protein in the Caribbean Islands.

Island/nation	Resident consumption rate[1] (kg/person/year)	Resident fish consumption[2] (t/year)	Tourist fish consumption[3] (t/year)	Total demand (t/year)
Bahamas		5,446	235	5,681
Hispaniola				
Dominican Republic		136,808	598	137,406
Haiti		125,323	274	125,597
Jamaica	[4]30.1	145,458	773	146,231
Cuba		247,222		247,222
Bermuda		1,556		1,556
Turks and Caicos		197	23	220
Puerto Rico	[5]8.2	26,138	3,323	29,461
U.S. Virgin Islands	[5]16.4	1,558	2,347	3,905
British Virgin Islands	[6]34.1	429	235	664
Anguilla	[7]23.6	203	15	218
St. Martin		664	433	1,097
St. Barthelemy		130		130
Saba		26		26
St. Christopher-Nevis		1,230	63	1,293
St. Eustatius		37		37
Antigua-Barbuda	[8]25.9	2,020	169	2,189
Montserrat		367	30	397
Guadeloupe		8,411	231	8,642
Dominica	[9]41.4		27	27
Martinique		8,424	310	8,734
St. Lucia	[4]26.0	2,851	176	3,027
Barbados	[10]26.0	6,515	723	1,238
St. Vincent and Grenadines	[4]27.7	2,797	75	2,872
Grenada		2,883	57	2,940
Aruba		4,125	369	4,494
Curacao		1,635	134	1,769
Bonaire		234	44	278
Trinidad and Tobago		30,134	981	31,115
Cayman Islands		205	235	440

[1]Rate assumed at 25.9 kg/person/year unless otherwise noted.
[2]Computed by multiplying the population by consumption rate.
[3]Computed based on 7-day average stay and 46.3 kg/tourist/year consumption rate.
[4]Cole (1976).
[5]CFMC (text footnote 3).
[6]CDB. 1980. Appraisal report on fisheries development—British Virgin Islands, 43 p. On file at Caribbean Development Bank, Bridgetown, Barbados.
[7]D. A. Olsen and J. C. Ogden. 1981. Management planning for Anguilla's fishing industry. Eastern Caribbean Natural Areas Program, Christiansted, St. Croix, 43 p. Unpubl. rep.
[8]CDB. 1979. Appraisal report on fisheries development—Antigua, 46 p. On file at Caribbean Development Bank, Bridgetown, Barbados.
[9]J. Wylie. 1977-78. Pers. commun.
[10]Adams (1980).

Table 3.—Comparison between island shelf potential yield, fish landings, and demand for marine protein in the Caribbean.

Island/nation	Fish landings (t)	Potential yield[1] (t)	Demand (t)
Bahamas	[2]2,800	124,800	5,681
Hispaniola			
Dominican Republic	6,435	864	137,406
Haiti	2,500		125,231
Jamaica	7,227	2,080	146,231
Cuba	43,186	25,600	247,222
Bermuda	[3]468	331	1,556
Turks and Caicos	1,050	768	220
Puerto Rico	1,819	2,553	29,461
U.S. Virgin Islands	1,272	1,262	3,905
British Virgin Islands	692	2,930	664
Anguilla	760	2,875	218
St. Martin	1,000	2,875	1,097
St. Barthelemy	N/A	2,875	130
Saba	[4]40	2,686	26
St. Christopher-Nevis	27	564	1,293
St. Eustatius	40	564	37
Antigua-Barbuda	800	1,621	2,189
Montserrat	126	90	397
Guadeloupe	4,990	1,205	8,642
Dominica	500	301	27
Martinique	2,167	814	8,734
St. Lucia	2,200	349	3,027
Barbados	1,579	205	7,238
St. Vincent and Grenadines	379	832	2,872
Grenada	900	1,280	2,940
Aruba	[4]700	132	4,494
Curacao	[4]850	61	1,769
Bonaire	[4]100	52	278
Trinidad and Tobago	4,322	13,056	31,115
Cayman Islands	N/A	160	440
	88,947	193,785	774,540

[1]Available yield = shelf area × 0.64 t/km^2 (CFMC, text footnote 3).
[2]Nassau only.
[3]Shellfish only.
[4]G. van Buurt, Netherlands Antilles Department of Agriculture and Fisheries, 1982. Pers. commun.

times the sustainable yield. This demand figure is compared in Table 3 to the actual landings and the sustainable yield available for harvest.

Table 3 demonstrates several facts. First, few of the islands are currently supplying their own demand for seafood. Second, although current landings constitute less than 50 percent of the yield, most of that underexploited area is on the Bahama Bank. If the Bahama Bank is deleted from consideration, current landings of 87,000 t exceed the 66,000 t sustainable yield figure for the region. Thus, although local areas of potential expansion may exist, any increase in landings must come from expansion into currently unexploited resources.

Occurrence of Ciguatera in the Caribbean

Surveys of Halstead (1970), more recently by Bagnis[4], and our own surveys have supported statements that ciguatera is more prevalent in the islands north of Martinique. Areas of ciguatera risk in the eastern Caribbean are shown in Figure 1. Three primary centers of the toxin are shown. The first occurs in the area of Redondo between Antigua and Montserrat and was responsible for a significant outbreak of poisonings in Antigua in 1980. The second area occurs between the eastern edge of the Saba Bank and along the southern edge of the Anguilla Bank. Fish from this area are almost certainly responsible for the intoxication of nearly 70 persons in St. Croix in early 1981 (Lewis et al., 1981). The final center of toxicity occurs along the narrow shelf south of Norman and Peter Islands in the British Virgin Islands.

Figure 1 also shows that large areas of the southern Virgin Islands shelf, the Anguilla Bank, the Antigua-Barbuda Bank, and some of the other islands consistently produce toxic fish. The remaining shelf area is generally free of toxic fish, with some exceptions. This figure demonstrates the universality of

[4]Bagnis, R. 1978. Report of the Mission to the Antilles and Easter Island August 15 - September 25, 1978. Institute of Medical Research, Papeete, Tahiti, 58 p., unpubl.

risk assumed by seafood consumers in the Caribbean.

Historically, one "solution" to avoid poisoning has been to consume fish from only low-risk areas. Traditionally, fish buyers knew (or learned) which fishermen fished in these areas and altered their buying patterns accordingly. However, with the advent of more aggressive marketing practices, this familiarity is no longer feasible. Additionally, fish market owners frequently find that local fishermen are not sufficiently reliable in their supply and have begun to import fish from other areas. As our previous analysis has shown, surplus production is available only from the Anguilla Shelf, the Antigua-Barbuda Bank, and the Saba-Nevis area. As is shown in Figure 1, ciguatera is present on these shelves.

Another factor which has resulted in an increase in the presence of toxic fish in the market has been the relatively recent increase in "distant seas" fishing by Puerto Rican and St. Croix fishermen who fish throughout the northeast Caribbean. Until the mid-1970's, seafood consumers in these islands were generally certain that they were purchasing fish caught on their own island platform. Since that time, considerable investment has resulted in a fleet of Puerto Rican fishing boats which fish throughout much of the Caribbean. St. Croix fishermen, limited by the relatively small island shelf, have also begun to fish the Saba Bank. As a result, both islands have begun to receive fish landed from distant areas where fishermen may be unfamiliar with the incidence of toxicity.

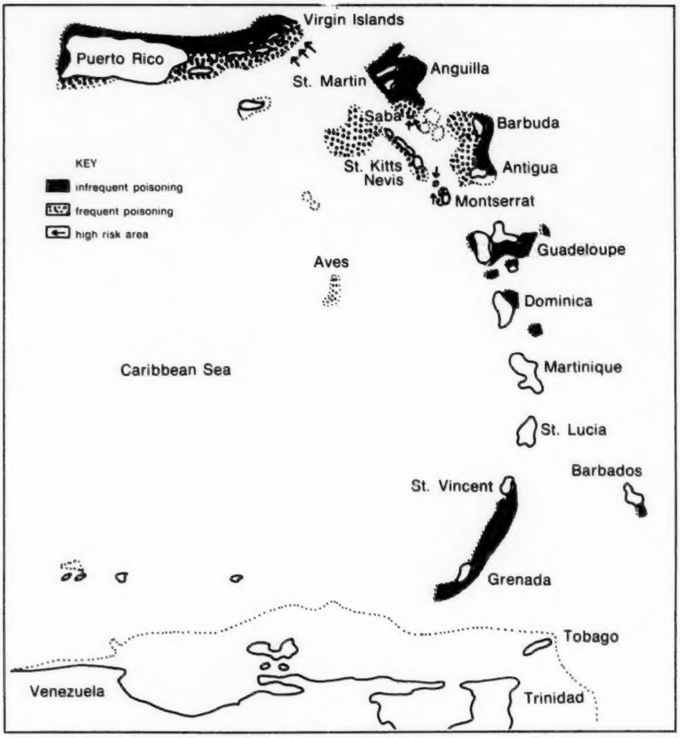

Figure 1.—Areas of ciguateric fish poisoning in the eastern Caribbean.

Which Fish Are Poisonous?

Several generalities can be used to summarize the body of information on which fishes tend to poison in the Caribbean. These are:

1) Toxic fish are generally associated with the island shelf benthic food chain. Pelagic fishes like dolphin and tuna are rarely, if ever, implicated in ciguatera intoxications (Randall, 1958).

2) Fishes in one local area may have a high level of toxicity, but the same species nearby may be relatively free of ciguatoxin. As an example, the south coast of St. Thomas is highly suspect, while the north coast is considered to be safe, as is St. Croix 40 miles to the south.

3) An area previously free of fish poisoning may suddenly give rise to an outbreak of toxic fish, then eventually return to a safe condition. Although documented only in the Pacific (Banner, 1967), circumstantial evidence for a similar phenomenon in the Caribbean is known to the authors.

4) Toxic fish are generally high in the food chain and are generally fish-eating predators. In the Caribbean where all species of fish are eaten, plant-eating, plankton-eating, and coral-eating fish tend not to be toxic.

5) A greater risk of intoxication is incurred when eating large individuals of any species than when eating small individuals of the same species.

These generalities are consistent with the body of knowledge accumulating on *Gambierdiscus toxicus*, the assumed ciguatoxin biogenitor (Bagnis et al., 1980). Following is an ecological model which explains the epidemiology of ciguatera.

Gambierdiscus toxicus is found abundantly as an epiphyte on the sessile algae such as *Dictyota*, *Turbinaria*, *Acanthophora*, and *Spyridia* making up the mixed community present on dead coral and other hard substrates in shallow water. As herbivorous species graze on the algae, they ingest the dinoflagellates and the toxin enters the food web. Depending on position in the food web, most members of the coral reef community are exposed to some of

the toxin. Since the toxin is extremely stable, and is accumulated throughout the life of the fish, it leads to higher concentrations in larger and older individuals, with more toxin present in the liver than in muscle tissue. As expected, species high in the food chain are more likely to carry large amounts of toxin. Individual food preference and availability can greatly alter these generalities: A large carnivorous fish may contain no significant toxin (Randall, 1958), while a small omnivore may produce a clinical case of poisoning. Certain species, because of diet preferences, may pose a high risk of toxicity, while closely allied species do not. Some examples from Division of Fish and Wildlife research will serve to demonstrate the above:

1) Greater amberjack, *Seriola dumerili*, is a highly suspect species; yet, a 23-pound individual from an area with a high incidence of ciguatoxic fishes proved nontoxic in a mongoose bioassay of its liver and subsequent human consumption.

2) Mutton snapper, *Lutjanus analis*, and dog snapper, *L. jocu*, commonly have overlapping home ranges, yet the former is considered to be toxin free, while the latter is commonly responsible for ciguatera intoxication.

3) The gastropod *Cittarium pica* is a prized and regularly consumed item of seafood considered to be free of ciguatoxin; yet, one of the authors contracted a suite of neurological symptoms characteristic of ciguatera after several consecutive meals of *C. pica* collected near the previously mentioned Norman Island center of ciguatoxin. (*C. pica* grazes primarily on shallow sessile algae.)

We believe that ecological conditions may support a continuous population of dinoflagellates, resulting in an area with a high level of ciguatoxic fishes. A transient supply of nutrients or suitable substrate might result in a bloom of *G. toxicus*, which creates a pulse of toxin into the food chain. As this toxin reaches the carnivorous fish consumed by humans, a short-term epidemic of ciguatera could occur in a previously safe area (Banner, 1967).

The final point to be made involves the generally accepted idea that specific knowledge of which fishes are most often toxic will allow consumers to reduce risk of poisoning. In the Virgin Islands, many fish importers, through careful selection of species and sources, are convinced that they are eliminating risk. Although most fish consumers in the Caribbean are aware of the more common fish which poison (great barracuda, *Sphyraena barracuda*; greater amberjack, etc.), many are unaware of the widespread distribution of ciguatoxin throughout the food chain. Although they may certainly be successful in reducing risks, the lack of a definitive test for toxins precludes risk elimination.

To demonstrate the wide distribution of ciguatoxin, we have presented in Table 4 a list of the fish landings in St. Thomas and indicated high-risk species, frequent poisoners, infrequent poisoners, and generally safe species. This list is derived largely from interviews and information acquired from Virgin Islands fishermen. In St. Thomas, high-risk species are generally not landed and are underrepresented on this list. Table 4 shows the complexity of the choice facing consumers between species desirable for eating and those safe for consumption, as they choose from among the 85 species which appear in this list. The summary results indicate that only 44 percent of the landings by poundage and 50 percent of the species can be considered to be effectively without risk. It should also be noted that many of these "safe" species are among the less desirable. A considerable ability to identify species is required to select safely among those more highly prized, such as the snappers and groupers.

Summary

The following observations would appear to characterize the fishery impact of ciguatera in the eastern Caribbean. First, fish is an important staple of the eastern Caribbean diet. Demand for it far outstrips both current catch levels and the potential of the resources to supply it. Consequently, any action or phenomenon which reduces the amount of harvestable marine protein may nutritionally affect the populations of less developed nations and economically exacerbate undesirable balance-of-payments problems when substitute sources are imported.

Secondly, ciguatera reduces the exportability of fish from the few areas which could conceivably export surplus available yield in exchange for foreign currency. The amount of this reduction has been estimated at between 2 and 15 percent of the available yield. In St. Thomas, as much as 64 percent of the poundage landed bears some risk of intoxication.

It follows, then, that improvement of the situation will require one of two events. The first, only remotely possible, would be the development of techniques to limit or predict an introduction of the toxin into the marine system. The second would be the development of a universally applicable field test to determine whether or not any given fish is toxic. In this way ciguatoxic fish poisoning may be substantially reduced as a major circumtropical health problem.

Acknowledgments

We would like to acknowledge the unpublished information we gathered at the National Marine Fisheries Service workshop on ciguatera held in San Juan, Puerto Rico, in 1981.

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Table 4.—Composition of Virgin Islands commercial fish catch in percent of pounds landed.

Family Genus, species, and common name	Rank risk[1]	Percent of landings[2]
Dasyatidae		
Dasyatis americana, southern stingray	4	
Orectolobidae		
Ginglymostoma cirratum, nurse shark	4	
Belonidae		
Tylosurus crocodilus, houndfish	3	0.45
Holocentridae		
Squirrelfishes		4.84
Holocentrus adscensionis, squirrelfish	3	
H. coruscus, reef squirrelfish	3	
H. rufus, longspine squirrelfish	3	
Serranidae		
Sea basses and grouper		0.60
Epinephelus adscensionis, rock hind	2	2.31
E. afer, mutton hamlet	4	0.60
E. cruentatus, graysby	3	
E. fulvus, coney	4	2.37
E. guttatus, red hind	3	8.71
E. morio, red grouper	2	0.84
E. striatus, Nassau grouper	4	2.25
Mycteroperca venenosa, yellowfin grouper	2	0.58
Hypoplectrus unicolor, butter (black) hamlet	4	0.60
Carangidae		
Seriola dumerili, greater amberjack	1	
Caranx crysos, blue runner	3	
C. latus, horse-eye jack	1	0.37
C. lugubris, black jack	1	
C. ruber, bar jack	1	0.75
Scombridae		
Scomberomorus cavalla, kingfish	2	2.34
Euthynnus alletteratus, little) tunny)	3	3.43
Sarda sarda, Atlantic bonito)		
Lutjanidae		
Apsilus dentatus, black snapper	3	0.07
Lutjanus analis, mutton snapper	4	0.13
L. apodus, schoolmaster	2	0.28
L. buccanella, blackfin snapper	2	0.81
L. campechanus, red snapper	3	
L. griseus, gray snapper	3	0.76
L. jocu, dog snapper	1	0.45
L. mahogoni, mahogany snapper	2	

Family Genus, species, and common name	Rank risk[1]	Percent of landings[2]
L. synagris, lane snapper	4	0.03
Ocyurus chrysurus, yellowtail snapper	4	2.89
Pristipomoides aquilonaris, wenchman	4	1.92
Muraenidae		
Gymnothorax funebris, green moray	2	
G. moringa, spotted moray	2	
Haemulidae		
Grunts (unidentified)		6.61
Anisotremus surinamensis, black margate	3	
A. virginicus, porkfish	3	
Haemulon album, margate	3	1.06
H. aurolineatum, tomtate	3	
H. bonariense, black grunt	3	
H. flavolineatum, French grunt	3	0.07
H. melanurum, cottonwick	3	0.04
H. plumieri, white grunt	3	0.35
H. sciurus, bluestriped grunt	3	0.05
Sparidae		
Porgies (unidentified)		3.48
Calamus calamus, saucereye porgy	3	0.15
C. penna, sheepshead porgy	4	
C. pennatula, pluma	4	
Mullidae		
Mulloidichthys martinicus, yellow goatfish	4	0.25
Pseudupeneus maculatus, spotted goatfish	4	0.74
Chaetodontidae		
Chaetodon capistratus, foureye butterflyfish	4	
C. sedentarius, reef butterfly fish	4	
C. striatus, banded butterflyfish	4	
Pomacanthidae		
Holacanthus ciliaris, queen angelfish	4	0.20
H. isabelita, blue angelfish	4	0.07
H. tricolor, rock beauty	4	0.20
Pomacanthus arcuatus, gray angelfish	4	3.03
P. paru, French angelfish	4	0.53
Scaridae		
Scarus coeruleus, blue parrotfish	4	1.84
S. croicensis, striped parrotfish	4	0.12
S. taeniopterus, princess parrotfish	4	0.09
S. vetula, queen parrotfish	4	0.10
Sparisoma aurofrenatum, redband parrotfish	4	0.19

Family Genus, species, and common name	Rank risk[1]	Percent of landings[2]
S. chrysopterum, redtail parrotfish	4	1.47
S. radians, bucktooth parrotfish	4	
S. rubripinne, redfin parrotfish	4	
S. viride, stoplight parrotfish	4	3.99
Labridae		
Bodianus rufus, Spanish hogfish	2	0.12
Halichoeres radiatus, puddingwife	4	
Lachnolaimus maximus, hogfish	3	1.06
Acanthuridae		
Acanthurus bahianus, ocean surgeon	4	0.12
A. chirurgus, doctorfish	4	3.73
A. coeruleus, blue tang	4	0.02
Sphyraenidae		
Sphyraena barracuda, great barracuda	1	
Scorpaenidae		
Scorpaena plumieri, spotted scorpionfish	2	
Bothidae, left-eye flounders	4	
Balistidae		
Aluterus scriptus, scrawled filefish	4	
Balistes vetula, queen triggerfish	2	29.68
Cantherhines pullus, orangespotted filefish	4	
Monacanthus ciliatus, fringed filefish	4	0.40
Ostraciidae		
Lactophrys bicaudalis, spotted trunkfish	3	0.08
L. polygonia, honeycomb cowfish	3	0.16
L. quadricornis, scrawled cowfish	3	0.27
L. triqueter, smooth trunkfish	3	0.21
Diodontidae		
Diodon holocanthus, balloonfish	3	
D. hystrix, porcupinefish	3	
Sciaenidae		
Equetus lanceolatus, jackknife-fish	4	
E. punctatus, spotted drum	4	
Ephippidae		
Chaetodipterus faber, Atlantic spadefish	4	
Pomacentridae		
Abudefduf saxatilus, sergeant major	4	

[1]Rank risk:	*% of landings (1b)*	*% of species*
1. High risk of poisoning	0.37%	3.5%
2. Frequent poisoners	33.05	10.5
3. Infrequent poisoners	21.88	36.5
4. Seldom poison	44.70	49.5
	100.00%	100.0%

[2]No figure = less than 0.01 percent.

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Proximate Chemical Composition and Fatty Acids of Three Small Coastal Pelagic Species

MALCOLM B. HALE

Introduction

Information on the proximate chemical composition and fatty acid profiles of a number of pelagic species has been developed at the Charleston Laboratory of the NMFS Southeast Fisheries Center. The data reported here are for Spanish sardine, *Sardinella aurita*; Atlantic thread herring, *Opisthonema oglinum*; and round scad, *Decapterus punctatus*. These species are placed in a common grouping referred to as "coastal herrings," for utilization purposes, although the round scad is actually a member of the jack family, Carangidae.

ABSTRACT—The coastal herrings complex comprises the largest underutilized fisheries resource in the Gulf of Mexico. Several species have good potential for food use as canned products, but the lack of chemical composition data inhibits their development. In this paper, proximate chemical compositions and fatty acid profiles are reported for seasonal samples of Spanish sardine, Sardinella aurita*; thread herring,* Opisthonema oglinum*; and round scad,* Decapterus punctatus*, from both the Atlantic Ocean and the Gulf of Mexico. Mean protein contents ranged from 20.6 percent for thread herring to 22.6 percent for round scad from the Gulf. Mean fat contents ranged from 1.8 percent for Spanish sardines from the Atlantic to 3.2 percent for thread herring from the Gulf. Fat contents of sardines and scad decreased over the period of spring to late summer. Spanish sardines have a particularly high level of 22:6ω3, but in general the fatty acid profiles of the three species were similar and did not change seasonally.*

Small pelagic species, primarily the herrings, the smaller jacks, and anchovies, make up the greatest underutilized finfish resource in the Gulf of Mexico (Reintjes, 1979). Based on egg and larval survey data reported by Houde (1976) and Leak (1977), the combined potential yield for thread herring, Spanish sardine, and round scad was estimated at 190,000-325,000 metric tons in the eastern Gulf of Mexico. Although menhaden are fully exploited for meal and oil production, and there are bait fisheries for other coastal herrings, there has been no significant direct food use of coastal herrings in the Gulf of Mexico.

Coastal herrings are generally small, dark fleshed, and bony. They contain moderate to high levels of oil, which is subject to oxidation during frozen storage. They are not suitable for traditional fresh or frozen products in developed countries but they have potential for use as canned products. Considerable interest has developed in recent years in the canning of coastal herrings, but very little information on the chemical composition of these species has been published to encourage such a development.

Thompson (1966) reported seasonal compositions of various species of Gulf of Mexico industrial fish. The fish, caught by commercial trawlers for a petfood canning plant, did not include the Spanish sardine or round scad. Seasonal proximate compositions were reported for whole thread herring, but fatty acids were not determined. Sidwell (1981) listed proximate analyses for several flesh and whole fish samples of thread herring and for several samples of sardine from the eastern Atlantic (*S. aurita*, but referred to as golden sardine). Round scad was not reported. Proximate and fatty acid compositions of raw and canned thread herring and Spanish sardine were included in a study of the effects of canning on fatty acids (Hale and Brown, 1983), which demonstrated that heat processing did not significantly alter the fatty acid profiles.

This paper includes some of those data along with other analyses for a range of seasonal samples. We also present information, not previously available, on the chemical composition of edible forms of the three small pelagic species with potential for much greater use.

Materials and Methods

Round scad and Spanish sardine were obtained from both the South Atlantic Bight and the Gulf of Mexico. The Atlantic samples were collected during resource survey cruises, sealed in heavy polyethylene bags, and frozen onboard the vessel. Thread herring, as well as scad and Spanish sardine, were obtained from the Gulf of Mexico. Samples were obtained from baitfish harvesters, primarily in Port St. Joe, Fla. (Raffields Fisheries), or in the Panama City, Fla., area. The samples

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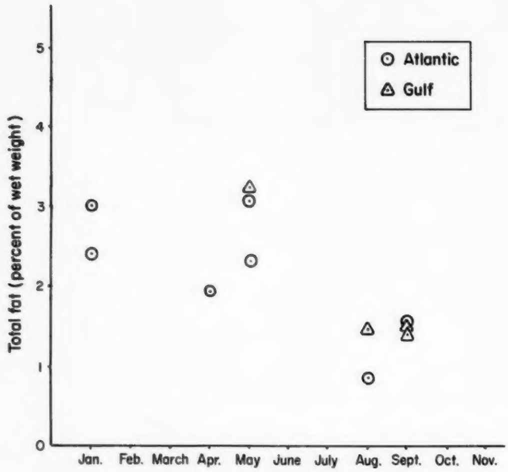

Figure 1.—Fat content of headed and gutted Spanish sardine, *Sardinella aurita*, versus month of harvest.

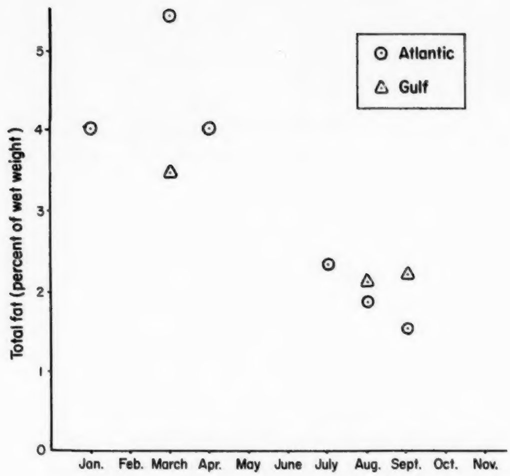

Figure 2.—Fat content of headed and gutted round scad, *Decapturus punctatus*, versus month of harvest.

were frozen before being transported to Charleston, S.C., for processing. Analyses were generally made after less than 2 months of frozen storage.

All samples were homogenized in a food processor, placed in polypropylene sample cups, frozen, and stored until analyzed. Samples were analyzed for crude protein by the Kjeldahl method (AOAC, 1965). Samples were dried to constant weight overnight at 100°C for moisture determination, and were heated overnight at 600°C for ash determination. Total fat was determined by a chloroform-methanol extraction (Smith et al., 1964). Duplicate analyses were performed on all samples.

Fatty acids were determined by gas-liquid chromatography of methyl esters. The esters were prepared from extracted oils by a boron trifluoride-methanol procedure (Metcalfe and Schmitz, 1961). A column packed with diethylene glycol succinate polyester (DEGS) was employed in a Hewlett-Packard[1] Model 5831A chromatograph with electronic integrator. Identification of fatty acid esters was as described by Ackman and Burgher (1965).

[1]Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

Table 1.—Proximate chemical analyses of the raw, headed, and gutted form of round scad, Spanish sardine, and thread herring.

Species	Source	Number of samples	Average weight (g)	Percent			
				Protein	Fat	Moisture	Ash
Round scad	Atlantic	11	35.1	21.64	2.52	74.06	3.12
	Gulf	3	36.8	22.60	2.60	73.95	2.60
Spanish sardine	Atlantic	6	33.4	20.83	1.79	76.05	2.68
	Gulf	6	60.9	20.90	2.42	74.73	2.69
Thread herring	Gulf	4	78.9	20.65	3.22	73.23	3.68

Results and Discussion

The coastal herring species described have high protein contents and moderate fat contents. Overall average values of the proximate chemical compositions determined for the raw, headed and gutted (H&G) forms of round scad, Spanish sardine, and thread herring are listed in Table 1. The samples referred to in Table 1 are composites of 8-20 fish each, depending on fish size. The H&G form is that most likely to be utilized in canned food products. The chemical compositions of samples from the Atlantic did not differ significantly from those of Gulf samples. Although Spanish sardines from the Gulf were larger, and had a slightly higher mean fat content, correlations between fish size and fat content were generally low. The fat content did vary with the season, however, apparently as a function of the reproductive cycle.

Fat content decreased in both Spanish sardine and round scad during the summer (Fig. 1 and 2). Samples were not available to describe the fat increase that must occur during the fall. The data available for thread herring indicate an increase in fat content dur-

ing the early fall. A September H&G sample approached 4 percent fat and an October skinless fillet sample exceeded 5 percent fat. Thompson (1966) reported for whole thread herring an increase from 4.3 percent fat in late September to 15.6 percent fat about 1 month later. The lowest and highest oil contents measured for thread herring by Thompson were similar to those measured for menhaden, but the median of all seasonal samples was much lower in thread herring (5.1 vs. 13.3 percent).

Proximate analyses of three product forms (skinless fillets, headed and gutted, and whole fish) are listed in Table 2. These are average values of the Atlantic samples of scad and sardine and of the Gulf samples of thread herring. Samples of whole thread herring were not analyzed.

The major fatty acids determined for the three species are listed in Table 3. The species exhibit a similar pattern, with high concentrations of 16:0 and 22:6ω3. Spanish sardines are particularly rich in the 22:6 fatty acid. The totals of the highly unsaturated fatty acids, containing 5 and 6 double bonds, range from 28.3 percent in the thread herring to 36.2 percent in the Spanish sardine. Recent research indicates that these fatty acids may help to prevent coronary attacks by reducing blood clotting rates as well as reducing cholesterol levels in the blood (Rawls, 1981). Erucic acid (22:1ω9), which has adverse effects on certain laboratory animals (e.g., heart lesions in male weanling rats) when fed at high levels, is quite low in these species. The total of all 22:1 isomers is only about 0.3 percent of total fatty acids.

The results of this study indicate that Spanish sardine, thread herring, and round scad have high protein and moderate fat contents during the normal period of availability. Fatty acid patterns are similar, with high concentrations of long-chained polyunsaturates. Additional data are needed to better describe fat content in the fall and winter, but the reported data should be of value for greater utilization of the abundant coastal herring resources.

Table 2.—Proximate chemical composition of three product forms of round scad, Spanish sardine, and thread herring.

Species and source	Product form	Percent			
		Protein	Fat	Moisture	Ash
Round scad (Atl.)	Fillet	22.22	1.90	75.71	1.42
	H&G	21.64	2.52	74.06	3.12
	Whole	20.03	2.96	74.18	3.89
Spanish sardines (Atl.)	Fillet	22.40	1.31	75.86	1.77
	H&G	20.83	1.79	76.05	2.68
	Whole	18.59	1.84	76.99	4.08
Thread herring (Gulf)	Fillet	20.63	2.58	75.68	1.36
	H&G	20.65	3.22	73.23	3.68

Table 3.—Major fatty acids of Spanish sardine, thread herring, and round scad.

Fatty acid[1]	Percent of total fatty acids		
	Spanish sardine	Thread herring	Round scad
14:0	2.8	4.7	3.9
16:0	23.2	23.8	20.5
18:0	7.7	7.8	9.3
16:1	4.8	5.6	6.0
18:1	8.6	10.6	11.7
20:1	0.9	1.3	1.1
22:1	0.3	0.3	0.3
18:2ω6	1.4	1.5	2.0
18:3ω3	0.5	0.9	0.9
18:4ω3	0.6	1.0	1.0
20:4ω6	2.6	3.3	2.7
20:5ω3	6.3	6.4	6.6
22:5ω6	1.7	1.5	1.6
22:5ω3	1.2	1.6	1.8
22:6ω3	27.0	18.8	20.0
Total saturates	37.7	42.1	36.2
Total monoenes	16.7	20.1	20.5
Total PUFA[2]	45.6	37.8	43.3

[1]For polyunsaturated fatty acids, the first number to the right of the colon indicates the number of double bonds and the last number is the number of carbon atoms separating the first double bond from the methyl end of the molecule.
[2]PUFA = Polyunsaturated fatty acids.

Acknowledgments

Jim Bonnet performed the proximate chemical analyses and Tom Brown performed the fatty acid analyses. Charles Barans and Charles Wenner of the South Carolina Marine Resources Research Institute, and Rick Dufresne of the National Marine Fisheries Service, Panama City, Fla., are thanked for their assistance in sample collection.

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Dungeness Crab Leg Loss in the Columbia River Estuary

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and THEODORE H. BLAHM

Introduction

Monetarily the Dungeness crab, *Cancer magister*, fishery is the most important crustacean fishery in the western United States from California to Washington. It is the second largest crustacean fishery in pounds landed and only the pandalid shrimp fishery is greater (PMFC, 1983).

Sampling was conducted from 1971 to early 1973 in the Columbia River estuary by personnel from the National Marine Fisheries Service (NMFS) to investigate the temporal incidence of leg loss and subsequent regeneration in Dungeness crab. Missing or newly regenerated legs could impair the crab's ability to move, feed, and molt—ultimately affecting survival. If decreased growth or survival occurs in a large portion of the population, there could be an adverse impact on commercial and sport harvests.

ABSTRACT—Sampling carried out in the Columbia River estuary from 1971 to 1973 to investigate the incidence of leg loss and subsequent regeneration among Dungeness crab, Cancer magister, *indicated an average of 45 percent of the catch had one or more missing legs. This is more than twice the frequency of leg loss reported in either Washington's Puget Sound or coastal waters. Leg injuries occurred with a high incidence of bilateral symmetry. Claws were lost and regenerated more frequently than any other pair of legs. Possible reasons for the high incidence of leg loss in the estuary are maintenance dredging, commercial crab and finfishing activities, predation, and competition.*

Methods

Commercial crab pots, as described by Waldron (1958), were baited and fished 1 day each month in the Columbia River estuary from late December 1971 until February 1973, except during July 1972 (Fig. 1). Although pots were placed at various locations throughout the western half of the estuary, most of the fishing effort was along the north side of Clatsop Spit and the south side of the Sand Islands. Both areas are in, or adjacent to, the two major deep channels of the estuary. Information recorded for each crab included the following: 1) Sex, 2) carapace width (mm) immediately anterior to the tenth anterolateral spine, and 3) position and number of missing or regenerated legs.

Crabs missing a leg for 1 or 2 days will form a scab or brown sheath covering the previous attachment site; very recent injuries (within hours) do not have the sheath. To eliminate including data on crabs that might have been injured in the trapping process, injuries that did not have the scab or sheath were not included in this study. Budding of a new leg was considered regenerated when it had broken through the sheath.

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Table 1.—Carapace widths for 3,085 Dungeness crabs from the Columbia River estuary, 1972.

Year and month	Male Number	Male Mean width (mm)	Female Number	Female Mean width (mm)
1972				
January	136	145	9	105
February	126	146	2	134
March	192	146	6	115
April	235	135	22	109
May	264	138	42	115
June	435	112	158	106
July				
August	61	127	22	127
September	233	136	49	122
October	265	142	8	125
November	335	144	5	129
December	212	146	9	116
1973				
January	180	141	9	125
February	70	142	0	0
Total	2,744		341	
Grand mean		136		113

Results

A total of 3,085 crabs were captured (Table 1). Males composed 89 percent of the catch with a mean size of 136 mm carapace width (range 70-197 mm). Females composed 11 percent of the catch with a mean carapace width of 113 mm (range 62-162 mm). Coincident with increased river flows during the spring freshet in June, the catch of large male crabs decreased dramatically, whereas the catch of smaller crabs of both sexes increased. The largest catches of crabs (593) were made in June; these crabs were also the smallest (mean width 110 mm).

The majority of crabs captured were less than the legal commercial size (159

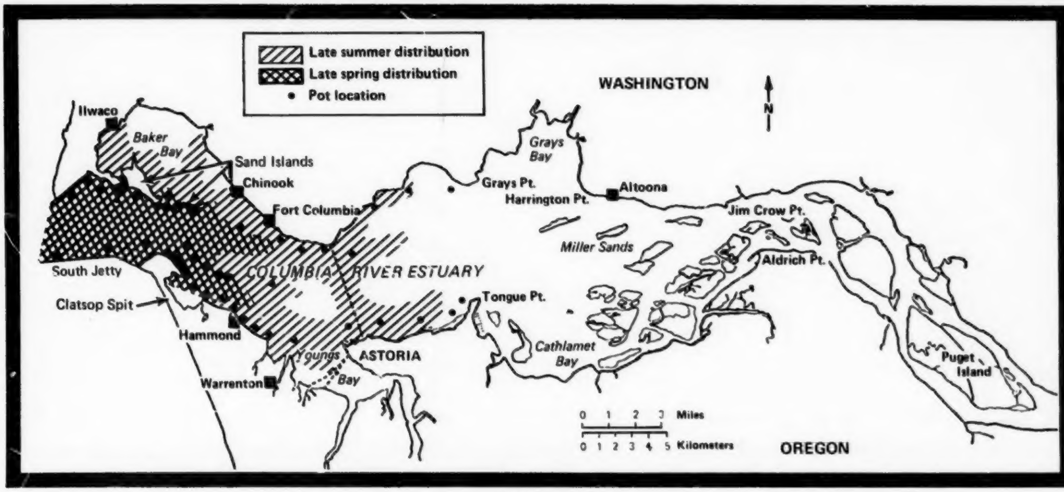

Figure 1.—Crab pot sampling locations and distribution of Dungeness crabs in the Columbia River estuary, 1971-73.

Table 2.—Monthly changes in the number and percentage of injured and intact Dungeness crabs from the Columbia River estuary, 1972.

Year and Month	Crabs with missing legs only		Crabs with regenerating legs only		Crabs with both missing and regenerating legs		Intact crabs	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1972								
January	57	39	32	22	21	15	35	24
February	53	42	21	16	27	21	27	21
March	88	44	36	18	41	21	33	17
April	71	28	52	20	54	21	80	31
May	90	29	64	21	72	24	80	26
June	157	27	90	15	50	8	296	50
July								
August	28	34	13	16	17	20	25	30
September	63	22	63	22	24	9	132	47
October	75	28	56	20	34	12	108	40
November	89	26	82	24	54	16	115	34
December	46	21	71	32	38	17	66	30
1973								
January	57	30	43	23	44	23	45	24
February	18	26	20	28	20	29	12	17
Total	892		643		496		1,054	
Average (%)		29		21		16		34

mm). The average size of both male and female crabs indicated they were sexually mature; however, no females with an egg mass (sponge) were captured.

Throughout the study, crabs with missing or regenerating legs composed 66 percent of the total catch (Table 2). In 1972, the percentage increased from January through March to a high of 83 percent, decreased to a low of 50 percent in June, and generally increased again through February 1973.

Injured crabs may exist in one of three conditions: Having 1) one or more legs missing but none regenerating, 2) one or more legs regenerating but none missing, or 3) at least one leg missing and one leg regenerating. During the sampling, 29 percent of the crabs caught had one or more legs missing (maximum of five) with none regenerating, 21 percent had one or more legs regenerating (maximum of five) with none missing, and 15 percent had legs missing and regenerating (maximum combined was six for one individual).

From June through September, when females were most abundant, 271 females and 993 males were examined. Sixty-one percent of the males were injured as were 45 percent of the females. The pattern of injury during the summer was identical to that for the entire study (i.e., crabs with missing legs but none regenerated were the most abundant, there were fewer with regenerated legs but none missing, and still fewer with legs missing and some regenerating).

Injuries occurred with obvious bilateral symmetry—of 3,920 legs that were lost or regenerated, 1,963 oc-

curred on the left and 1,957 on the right; missing legs occurred 1,104 times on the left and 1,106 on the right; and regenerating legs occurred 859 times on the left and 851 on the right. Chelipeds (claws) were injured more frequently than any pair or all of the walking legs collectively. Injury to the paired walking legs occurred in the following order of frequency: 1) First pair, 2) second pair, 3) fourth pair, and 4) third pair. Regardless of location, loss was more frequent than regeneration.

Discussion

Needham (1953) discussed leg loss and regeneration in eight species of crustacea and concluded that such injury paralleled the degree of exposure of the limbs. The claws and first, second, and last pair of walking legs are more exposed to damage by being near the ends of the crab. Consequently, these were lost more often than the third pair of walking legs. Needham also indicated there was a marked bilateral asymmetry of appendage damage in crustacea which tend to move predominantly in one direction, and a more symmetrical loss in those which move randomly. The frequency of bilaterally symmetrical leg injuries for Dungeness crab implies that they move randomly.

During our study, crabs with missing legs composed 45 percent of the total catch. This was more than twice that reported by either Cleaver (1949) or Ames[1]. Cleaver found in Washington coastal waters that 16 percent of the crabs examined in 1947 and 20 percent examined in 1949 had missing legs. Ames reported that a study in Puget Sound, Wash., from 1970 through 1972 found that 17 percent of the crabs caught in Port Gardner Bay had missing legs. Both studies involved primarily commercially legal male crabs; whereas only a small proportion of the total population in the Columbia River estuary attains this size—the estuary is a nursery for juvenile crabs.

There are many probable causes of the high frequency of crab injury in the Columbia River—natural and/or related to human activity. Predation by mammals or other crabs and competition for both food and space are probable natural causes. Human-related causes may include rough handling incidental to commercial crab and finfish (trawl and gillnet) fisheries, and maintenance dredging of the main navigation channel and entrance bar.

There is no comparable information on crab leg damage in other large, nearby coastal estuaries such as Grays Harbor and Willapa Bay, Wash., or Tillamook Bay, Oreg. These estuaries are much shallower than the Columbia River estuary and present a different environment to crabs, injured or not.

[1]Warren Ames, NMFS Northwest and Alaska Fisheries Center, Seattle, WA 98112. Pers. commun., 1980.

Summary

Dungeness crabs taken with pots in the Columbia River estuary in 1972-73 had a high percentage of injury. The degree of injury was much greater than that found either in Washington coastal waters 25 years earlier, or in Puget Sound from 1970 to 1972. It is not known whether this is a common occurrence in the estuary, or if it still exists. The effect of the injured population on the subsequent numbers of harvestable adults in coastal waters was not determined.

Acknowledgments

We wish to thank Roy Pettit and Nick Zorich for their efforts in completing this study. Their participation in vessel operation and crab collection and measurement was essential.

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"Year of the Ocean" Celebrates Marine Importance

The "Year of the Ocean," from 10 March 1984 through 10 March 1985, has been initiated and designed to celebrate and call attention to the importance and value of the ocean to human life. Start of the year-long observance was set in honor of the first anniversary of President Ronald Reagan's Proclamation of the Exclusive Economic Zone (EEZ).

Education and Stewardship

While that Proclamation extended U.S. sovereign rights and jurisdiction to the many resources found within 200 miles of our shores, Year of the Ocean festivities are not limited to the EEZ. It is to celebrate all ocean areas with particular focus on education and stewardship. Federal organizations with ocean missions will open their doors at various times throughout the year to welcome the public, especially students, to view their facilities and become familiar with their many activities. This special celebration is expected to spark new interest in the exploration, research, development, use, and enjoyment of the seas around us.

Purpose and Objectives

The major purpose of the "Year of the Ocean" is to increase awareness of our bond with the ocean—the ocean is our benefactor and continues to offer great potential. The Ocean Year celebration should result in a more informed and effective public on ocean issues. Public evaluation of the Nation's policy posture will serve the entire world well as we approach the 21st Century.

Stated objectives of the Year of the Ocean are to:

1) Foster Federal, State, and industry partnership in wise use and management of the ocean and its resources.

2) Educate and inform Americans about the products, use, and potential of the ocean.

3) Encourage ocean users to develop a stewardship role in addressing the use and management of our ocean resources for present and future Americans.

4) Provide a neutral forum for policy- and decision-makers to raise, examine, and/or recommend resolution of ocean issues.

5) Initiate and stimulate multiple celebrations of America's ocean heritage and future.

A new organization, the Year of the Ocean Foundation (see box), is sponsoring the observance. Composed of oceanic leaders in government, industry, academia, private organizations, and state and local governments, its sole purpose is to increase the American public's understanding of the importance of the oceans. The new Foundation will operate for 2 years.

Year of the Ocean Foundation

Foreseeing the possibility of "a new American heritage," the Year of the Ocean Foundation has been established to sponsor Year of the Ocean activities. The Pro Tem Executive Committee for the Foundation included John V. Byrne, Charles D. Matthews, Cliff McLain, Richard Shamp, and Charles H. Bussman. National Coordinator of the Year of the Ocean is Diane C. Boratyn at Foundation headquarters, Box 1100, 3421 M Street, N.W., Washington, D.C. 20007 (telephone is 202-333-1188).

The Foundation was set up to stimulate public and private partnership, provide communication between ocean users, initiate ocean events, and inform the public about the oceans. It will provide a headquarters staff to coordinate events and expedite the involvement of industry, academia, and other organizations in the year-long program of observances.

NOAA's Role

NOAA's ocean organizations plan to conduct a series of events during the Ocean Year to reach people across the Nation and to give the ocean new meaning in their lives. Planning sessions have been held at national, state, and local levels to produce a year-long calendar of exciting and educational events. And, Congressional resolutions for the Ocean Year and a "Day of the Ocean" are under consideration.

The National Marine Fisheries Service will also be an active participant in the Year of the Ocean celebrations. On 9 March, NOAA facilities in at least 12 locations were opened to conduct educational programs and facility tours for grade school science classes. Additional details on upcoming Ocean Year events and educational activities are available from NOAA and NMFS regional offices.

Keynoting the Coastal Zone 83 conference on 1 June last year in San Diego, NOAA Administrator John V. Byrne proposed that 1984 be the "Year of the Oceans." In his wide-ranging speech, Byrne called for State governments and private interests to exercise leadership in their areas of interest to provide the Nation with strong ocean and coastal programs, and he pledged that NOAA would assume its share of leadership.

Define and Clarify Goals

Said Byrne, "We now have an unparalleled opportunity to define and clarify the Nation's ocean and coastal goals, and rally the support needed to achieve them. I propose that we, and all who are interested in coasts and oceans, make next year, 1984, the "Year of the Oceans"... I believe that the Year of the Oceans will help us achieve a consensus about needs to be met and programs to be undertaken. And I believe that it will enable us to move into the 21st

Century with our National directions clear, and with science and technology on track to meet the challenges that lie ahead."

Addressing science, Byrne noted that NOAA was fortunate to have many excellent scientists whose knowledge and skills "can often be linked to provide solutions to problems broader than might be met in their single disciplines."

Fisheries

On fisheries, Byrne said, "Fish stocks are large or small, in general, depending on how well the juveniles survive to become adults. Only recently have scientists discovered how heavily this survival depends upon physical oceanographic factors such as currents, turbidity, and salinity, as well as biological factors such as predation.

"Our oceanographers and fishery biologists are now pursuing joint research on the factors that influence juvenile survival. Recent advances have put us on the threshold of major predictive capabilities for several important fish stocks.

"We think the Year of the Oceans will see important advances toward our goal of increasing the catch of our fishing industry."

Estuarine Research

Likewise, estuarine research is another practical and productive area, according to Byrne, citing progress at the NMFS Galveston and Beaufort fisheries laboratories in learning the importance of spartina marsh grass for juvenile shrimp and menhaden.

NOAA participation in the Year of the Ocean is coordinated by its National Ocean Survey (NOS), according to Ruth Barritt in NOS' Office of External Affairs. Several special science programs for school children to initiate the Year of the Ocean celebration were held on 9 March by NOAA elements in the following cities: Seattle, Wash.; Miami, Fla.; Charleston, S.C.; San Diego and La Jolla, Calif.; Boulder, Colo.; Bay St. Louis, Miss.; Norfolk, Va.; Rockville, Md.; Kodiak and Anchorage, Alaska; and Narragansett, R.I., and others.

NMFS SCIENTISTS HONORED

Shomura Receives NOAA Administrator's Award

Richard S. Shomura, Director of the Southwest Fisheries Center's Honolulu Laboratory since 1973, received NOAA's Administrator's Award from John V. Byrne, Administrator of NOAA, in ceremonies last fall in Washington, D.C. The Award consists of a plaque and stipend of $2,000 and is given annually to at most 10 NOAA employees (NOAA employs almost 15,000 persons) who have made significant contributions to NOAA's programs.

Shomura was cited for his efforts in bringing together a diverse group of scientists at a symposium held at the University of Hawaii in May 1983. The scientists shared results of studies on the fish and wildlife of a group of islands and atolls extending over a thousand miles northwest of Hawaii. These islands and atolls, especially Midway, have strategic military importance and harbor some of the world's most important seabird colonies as well as many commercially and recreationally valuable fish and shellfish. These islands also provide terrestrial habitat for the endangered Hawaiian monk seal and green sea turtles.

Shomura was also commended for his initiative and leadership in dealing with problems of assessing fishery resources and improving fishery management in underdeveloped areas of the Pacific. Shomura holds a Master of Science degree in zoology from the University of Hawaii and is the only locally born person to hold the laboratory director's position since the Honolulu Laboratory was established.

Reuben Lasker Receives Excellence Award for Marine Science Studies

Reuben Lasker, a NOAA Gold Medal Winner and Chief of the Coastal Fisheries Resources Division at the NMFS Southwest Fisheries Center, added to his list of honors with the announcement that he is the 1983 recipient of the A. G. Huntsman Award for excellence in marine science. Lasker was notified of the honor by the Huntsman Award Committee at the Bedford Institute of Oceanography (BIO) in Dartmouth, Nova Scotia, Canada.

The Huntsman Award was established in 1980 by BIO and is presented annually in one of the three divisions of marine science—biological oceanography, physical/chemical oceanography, and marine geoscience. It recognizes excellence of research, outstanding contributions to science, and influence on the course of marine scientific thought. Recipients are honored not only for their caliber of science and scientific thought, but also for their impact and influence on the future of oceanography.

In a prepared statement the Award Committee said: "Dr. Lasker is a highly regarded teacher and researcher in the field of biological oceanography who has a profound influence on our understanding of the nutrition, biochemistry, and general physiology of marine organisms. He has pursued a lifetime search for the causes of fluctuations in the abundance of fish populations, concentrating on the sardines and anchovies of the California Current, as models of fish stocks everywhere. Starting from laboratory studies on the bioenergetics of eggs and larvae in the early 60's, he developed a mechanism for spawning anchovies on demand in the laboratory. This significant breakthrough in the supply of research material enabled him to progress rapidly through studies of larval feeding behavior to critical experiments at sea for determining the oceanographic conditions necessary to establish sufficient

food conditions."

The work by Lasker and his colleagues at the SWFC La Jolla Laboratory, the awards committee concluded, "is a most elegant combination of laboratory physiology and biological oceanographic field work...(which) culminated in the late 1970's with a first demonstration of how good and poor year-classes of fish, in this case, anchovy, might be formed that has resolved old questions, and has led to a worldwide resurgence of research in this important field."

Lasker received the specially designed and engraved sterling silver medal at ceremonies in November in the BIO auditorium from the President of the Royal Society of Canada, Marc-Adelard Tremblay. Following the ceremony the medalist presented a distinguished lecture. The Huntsman Award is supported jointly by the Canadian Departments of Fisheries and Oceans; Energy, Mines and Resources; the East Coast Petroleum Operators Association, and the Provincial Department of Fisheries.

Lasker is a long-time Federal employee who joined the NMFS in 1958 as a research physiologist. He is married to the former Caroline Hayman and has two grown children.

Outstanding NMFS Authors Are Cited

The outstanding papers authored by National Marine Fisheries Service scientists and published in the *Fishery Bulletin* and the *Marine Fisheries Review* in 1982 have been announced by the NMFS Publications Advisory Committee.

For the *Fishery Bulletin*, Vol. 80, Thomas Pothoff and Sharon Kelly shared the award for their top-rated paper "Development of the vertebral column, fins, and fin supports in the swordfish, *Xiphias gladius*," 80(2): 161-186. Pothoff, a fishery biologist, and Kelly, a research assistant, are both with the Miami Laboratory of the NMFS Southeast Fisheries Center, Miami, Fla.

Selected as the best paper published in 1982 in the *Marine Fisheries Review* was "A review of the offshore shrimp fishery and the 1981 Texas Closure," by Edward F. Klima, Kenneth N. Baxter, and Frank A. Patella, Jr. Klima is Director of the Galveston Laboratory of the NMFS Southwest Fisheries Center, Galveston, Tex. Baxter, a supervisory fishery biologist, and Patella, a fishery biologist, are also stationed at the Galveston Laboratory. The paper was published in the September-October issue, 44(9-10):16-20, and was part of a special double-size issue devoted to the "Texas Closure."

Developed in 1975, the annual Outstanding Publication Awards program recognizes NMFS employees who have made exceptional contributions to the knowledge and understanding of the resources, processes, and organisms studied as a part of the NMFS mission.

Any NMFS employee may recommend published papers of the appropriate calendar year for award consideration to the chairman of the Publication Awards Committee (the current *Fishery Bulletin* editor). Authors must have been employed by the NMFS at the time the paper was published. Nominations must include the author's name, paper title and number of pages, series name and volume number, justification to support the nomination, and the name and office affiliation of the nominator.

Drilling Mud Effects on Planktonic Crustaceans

Muds used in drilling offshore oil wells pose little threat to sensitive larval stages of several species of shrimp and crabs, according to a study recently completed by Stanley D. Rice and Mark Carls at the NMFS Northwest and Alaska Fisheries Center's Auke Bay Laboratory in Alaska. This finding is reassuring to those concerned about effects of the mud on fish resources. About 1 ton of solids (mud mixed with rock chips) is dumped at sea for each 10 feet of well drilled. Because both the number of wells and their depths are increasing rapidly on the continental shelf, possible toxic effects of muds have become an issue.

Effects of six muds—four used muds from actual drilling operations, and two unused—were tested on six species of crustacean larvae: King, snow, and Dungeness crab; and coonstripe, dock, and kelp shrimp. Tests on sensitive planktonic larvae of crabs and shrimp had not been conducted before this study. Toxicity of the muds varied with the composition of the mud and species tested. Concentrations of mud-seawater suspensions that killed 50 percent of the animals in 144 hours of exposure ranged from 0.05 to 2.98 percent by volume. Mud toxicity was much less than that of crude oil—even the most toxic mud was only about 1/1,000 as toxic as Prudhoe Bay crude. No harmful effects were evident from any muds until after at least 4 hours of continuous exposure to these high concentrations.

Several mud components were also tested separately for toxicity. Ferrochrome lignosulfonate, a dispersant commonly added to mud formulations in small quantities, was the most toxic component tested. Barite ($BaSO_4$) and bentonite clay, which usually make up the bulk of mud formulations, were relatively nontoxic. Effects at the highest mud concentrations were probably caused by physical interference with larval behavior rather than chemical toxicity.

Under most conditions, drilling muds discharged into the sea are unlikely to harm planktonic larvae because toxic concentrations are diluted rapidly within a short distance from the point of discharge (thousandfold dilutions have been measured in other studies within 5 m of the discharge). Drilling muds settling on the bottom near the point of discharge could affect some benthic organisms, but this question was not addressed. Results of the study will be published in *Marine Environmental Research*. Additional details concerning the drilling mud toxicity study are available from George Snyder, Director, NMFS Auke Bay Laboratory, Auke Bay, AK 99821.

NMFS Announces New Habitat Conservation Policy

A new habitat conservation policy to ensure that habitat is given greater attention in agency programs has been adopted by the National Marine Fisheries Service, agency officials have announced. After extensive internal and public scrutiny, the national policy was approved by William G. Gordon, Assistant Administrator for Fisheries, NMFS, Washington, D.C., and published in the *Federal Register* late last year.

The new policy will:

1) Ensure that habitat is fully considered in all NMFS programs and activities.

2) Focus NMFS habitat conservation activities on species for which the agency has management or protection responsibilities under the Magnuson Fishery Conservation and Management Act, the Marine Mammal Protection Act, and the Endangered Species Act.

3) Lay the foundation for management and research cooperation on habitat issues.

4) Strengthen NMFS partnerships with the states and the Regional Fishery Management Councils on habitat issues.

The Nation's eight Fishery Management Councils are responsible for preparing fishery management plans for fisheries within their jurisdiction. Where appropriate, the Councils recommend habitat conservation measures in their fishery management plans. Because fish don't recognize boundaries between state and federal waters, it is vital for the states, the Councils, and the Federal government to cooperate on habitat and fishery issues.

Coastal and estuarine areas and their associated wetlands are vitally important as spawning and nursery grounds for both commercial and marine recreational fishery resources. About two-thirds of the important fishery resources depend upon these areas which also serve as habitat for many species of marine mammals and endangered species. However, human population shifts to coastal areas and associated industrial and municipal expansion have accelerated competition for use of the same habitats. By 1990, about 75 percent of the U.S. population is expected to live within 50 miles of the coastlines.

Increasing efforts to develop new or alternate sources of energy are further stressing important marine resource habitats. As a result, these habitats have been substantially reduced and continue to suffer the effects of dredging, filling, coastal construction, energy development, pollution, waste disposal, and other human-related activities. In the case of wetlands, from 1954 to 1978 there was an average annual loss of 104,000 acres, a tenfold annual increase in acreage lost between 1780 and 1954.

The NMFS' habitat conservation activities will, however, recognize that multiple uses of marine areas are necessary. The agency's responsibility is to see that such uses are balanced so that our important marine resources are minimally affected or, where possible, improved. NMFS is the primary Federal agency charged with conserving, managing, and developing marine fishery resources and protecting certain marine mammals and endangered species.

Liquid CO_2 Extraction and Fisheries Research

A new solvent extraction system with potential for widespread applications in fishery processing has been developed recently according to the Northwest and Alaska Fisheries Center's Utilization Research Division (URD). The process involves high pressure fluid extraction to concentrate and recover useful products such as perfume essences, oil from seeds, active ingredients from plants, and removal of caffeine from coffee. High pressure carbon dioxide has been evaluated in products such as corn oil and cottonseed oil with good success. Results of this research have been encouraging to URD scientists who have procured the necessary equipment to begin in-house investigations of the potential application to fishery products.

The carbon dioxide extraction process is quite simple. The carbon dioxide is first liquefied by compression at pressures of 4,000-10,000 psi. The high pressure liquid is then passed through an extraction vessel that may contain either liquid oil or solid material that contains the compounds to be separated. Specific fractions are recovered from the extraction process and can be isolated. Carbon dioxide is nonflammable, nontoxic, readily available, cheap, and easily removed from the material extracted.

The most promising areas that present opportunities for innovative research include refining fish oils to prepare good grade oils and pharmaceutical products, extraction of oils from fish meal or press cake, and the extraction and concentration of carotenoid pigments from crustacean processing wastes. Fractionation of methyl esters derived from fish oil triglycerides would yield concentrates of the highly unsaturated components with possible use for the treatment and prevention of cardiovascular disease. The extraction system has been assembled in the URD's Seattle laboratory and will be operated by Virginia Stout.

Richard W. Nelson

Fishery Product Safety Research

Fish and shellfish accumulate trace amounts of chemical contaminants to varying degrees, harbor pathogenic bacteria and viruses, and accumulate

naturally occurring marine toxins, all of which are capable of causing human illness. This is an impediment to expanding domestic and export markets for U.S. fishery products and can severely impact the stability of existing markets.

S-K 1983 funds totalling $742,000 will support research in the hepatitis A virus, cleansing mechanisms of *Vibrio cholerae* and *V. vulnificus* in Florida shellfish, the detection of ciguatera, the development and field testing of detection kits for paralytic shellfish poison, use of liquid smoke in fishery products to inhibit *C. botulinum*, use of controlled atmosphere to extend the shelf life of packaged seafood, and the commercial heat sterilization of seafood packed in retortable pouches. For more information on product safety projects contact: Betty Hackley, National Marine Fisheries Service, Office of Utilization Research, Washington, D.C. 20235.

U.S. West Coast 1984 Groundfish Rules Set

New regulations governing fishing for certain species of groundfish in the Pacific Ocean off Washington, Oregon, and California were put into effect 1 January 1984. These Federal regulations implement the Pacific Coast Groundfish Plan developed by the Pacific Fishery Management Council and have been coordinated with the fishery agencies of the three coastal states. The regulations apply to widow rockfish, rockfish of the *Sebastes* complex, and sablefish, and are as given below.

Vessels harvesting widow rockfish in the Pacific Ocean off the three states are limited to one trip per calendar week (Sunday through Saturday) which lands more than 3,000 pounds of widow rockfish. No more than 50,000 pounds (round weight) of this species may be taken and retained or landed in any one trip. All landings of widow rockfish must cease when the quota of 9,300 metric tons (t), about 20.5 million pounds, is reached.

Vessels harvesting the *Sebastes* complex in the area north of Cape Blanco, Oreg., are limited to one trip per calendar week above 3,000 pounds of fish of those species. No more than 30,000 pounds of fish in the *Sebastes* complex may be taken and retained or landed in any one trip. There is no harvest quota for fish of the *Sebastes* complex north of Cape Blanco at this time.

Regulations for the *Sebastes* complex in the area south of Cape Blanco limit each vessel to 40,000 pounds landed per trip. There is no limit on the number of landings allowed per week and there is no quota for the *Sebastes* complex south of Cape Blanco at this time.

Regulations for sablefish continued the minimum size limit of 22 inches of 1983. Vessels fishing for sablefish north of Point Conception, Calif., will be allowed to take and retain or land 5,000 pounds of sablefish under 22 inches in length per trip. South of Point Conception there are no size restrictions or trip limits for sablefish. All fishing for sablefish must stop when the coastwide harvest quota of 17,400 t (38.3 million pounds) is reached.

These regulations were to be reviewed in April and again in July by the Pacific Fishery Management Council and may be modified if the expected reduction in total catches is not realized.

Commercial Newsletter Pilot Project

The U.S. Department of Commerce has started a commercial newsletter project to enable small- and medium-sized U.S. exporters to test new markets on a regional basis with a minimum outlay. The project is aimed at new-to-export and new-to-market firms who wish to test the Asian or northern European markets, and who do not seek representation at this time.

The market test items will be published by the U.S. Embassies in London and Manila in a regional newsletter. Each copy of the newsletter will contain a reader interest card which may be marked and returned. Responses will be forwarded to advertisers. The product information inserts will be identified as commercial advertising for which the client will be charged an insertion fee of $25.00 per region. For further details, call or write: U.S. Department of Commerce, International Trade Administration, District Office, 441 Stuart Street, Boston, MA 02116 (telephone 617-223-2314).

Western Pacific Fisheries Development

In the Pacific Ocean, priority is given to projects that address tuna harvesting and/or contribute to the fishery development goals of Hawaii, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands and the Trust Territories of the Pacific Islands.

With $248,000 in S-K funds, the Pacific Tuna Development Foundation will continue its Pacific fisheries development program. The trochus reef reseeding program will continue. Reef areas in Palau will be stocked with juveniles of the giant tridacnid clam. A study will determine the feasibility of using Palau, Truk, Saipan, Ponapae, and Majuro port facilities for 500-1,000 ton transshipments of tuna.

A suitable location will be investigated for drydock facilities to repair the locally based fishing fleet of Truk. Cultured Mexican topminnows will be tested as live bait for aku, pole and line fishing, and fish aggregating devices. Efforts will be continued to expand the American Samoa fishery fleet, improve on-board and shoreside quality control, establish guidelines for air export shipments, and train local market employees in sales and quality control procedures.

Two other projects recommended for funding include the continuation of the small-scale tuna longlining effort centered in Guam, and support of a private industry committee in Hawaii to organize local seafood promotion activities on an industry-wide basis. Further Western Pacific project information can be obtained from: Peter Milone, NMFS, P.O. Box 3870, Honolulu, HI 96812.

Japan's 1982 Fisheries Production Reaches Record High

Japan's annual landings of fisheries and fish culture products for 1982 hit a new high, aided by a record-setting performance by the offshore fisheries and improved catches by the coastal fisheries, according to statistics released by the Ministry of Agriculture, Forestry, and Fisheries. The total catch for the year was 11,388,000 metric tons (t), a 1 percent gain over the previous high of 11,319,000 t in 1981, and kept Japan the world's leading fishing nation.

Table 1.—Japan's fisheries catch by type of fishery, 1979-82.

Fishery	Catch (1,000 t)			
	1979	1980	1981	1982
Marine				
Distant-water	2,066	2,167	2,160	2,089
Offshore	5,458	5,705	5,938	6,070
Coastal	1,953	2,037	2,045	2,072
Culture	883	992	960	938
Freshwater				
Fishing	136	128	124	122
Culture	95	94	92	96
Total	10,590	11,122	11,319	11,388

Species

Major species landed by Japanese fishermen were sardine (3.3 million t), Alaska pollock (1.6 million t), mackerel (0.7 million t), and squid (0.5 million t). By species, significant gains were recorded in the catches of herring (+172 percent), jack mackerel (+42 percent), and saury (+ 29 percent), whereas sharp declines occurred in rockfish (−40 percent), small yellowfin tuna (−31 percent), and bluefin tuna (−24 percent).

Table 2.—Japan's marine fisheries catch by selected species, 1981 and 1982.

Species	Catch (t) 1982	Catch (t) 1981	Species	Catch (t) 1982	Catch (t) 1981
Tuna			Cod		
Bluefin	44,205	58,485	Cod	95,127	102,205
Albacore	70,043	64,082	Alaska pollock	1,566,961	1,595,302
Bigeye	131,772	110,513			
Yellowfin, large	114,219	110,008	Subtotal	1,662,088	1,697,507
Yellowfin, small	11,903	17,190			
			Atka mackerel	102,884	122,839
Subtotal	372,142	360,278	Rockfish	16,635	27,776
			Croaker	30,210	33,358
Skipjack			Hairtail	35,948	35,097
Skipjack	302,982	289,286	Sea bream	27,435	26,567
Frigate mackerel	17,123	16,205	Spanish mackerel	5,744	6,181
Subtotal	320,105	305,491	Dolphin fish	13,648	12,683
			Flying fish	8,751	9,097
Billfish	44,479	47,455	Sandlance	126,659	162,448
Shark	34,983	36,978	Shrimp	59,064	54,048
Salmon	136,309	149,845	Crab	90,343	76,227
Herring	24,197	8,901	Common squid	181,721	196,830
Sardine	3,324,749	3,339,182			
			Cuttlefish	7,661	7,072
Jack mackerel	174,213	122,231	Other squid	361,053	312,598
Mackerel	717,840	908,015	Octopus	43,206	52,236
Saury	206,958	160,319	Sea Urchin	26,975	23,984
Yellowtail	38,443	37,774	Shellfish	351,297	355,128
Flatfish	275,377	296,572			

Sardine, Alaska pollock, and mackerel together accounted for 55 percent of the total marine catch for 1982. The landings by major fisheries and species are shown in Tables 1 and 2. Sardine has ranked first in quantity since 1978. The third ranking species, mackerel, at 717,840 t, showed a decrease of 21 percent over 1981.

Trade Deficit

The Japanese reported yet another fisheries trade deficit—the 12th in a row—as 1982 imports were valued at $4.2 billion while exports reached only $1.1 billion. During 1982, Japan imported 1.2 million t of fishery products, mostly fresh, chilled, or frozen fish. Japanese exports of fishery products totaled 715,000 t, with canned items (237,000 t) the most important.

The United States was again Japan's most important fisheries trading partner in 1982. Japanese fishery imports from the United States were valued at $706 million while exports to the United States amounted to only $244 million. One of the most notable developments in 1982 was the expansion of joint ventures with U.S. fishermen, primarily involving over-the-side sales of fish for processing on Japanese vessels.

The U.S. Regional Fisheries Attache for Asia at the U.S. Embassy in Tokyo has prepared a 17-page report surveying the 1972 Japanese fisheries. U.S. companies can obtain a copy of this report for $7.00 by ordering report number PB 84-116375 from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

Japan Opens First U.S. Fish Trade Offices

The Japanese Fisheries Association opened a fisheries trade office in Washington, D.C., last fall. The office is part of an agreement between both governments to facilitate trade. Japan agreed to staff the office with people knowledgable in trade and technology and to provide information regarding the Japanese fishery market.

The Washington office of the Japan

Fisheries Association is headed by Hiroyuki "Hugh" Takagi, a veteran Japanese fisherman and trade official, who has been helpful in expanding U.S. joint ventures and trade. U.S. officials accepted the trade office offer after the Japanese proposed it as the way to assist U.S. firms to penetrate Japan's extensive fishery products market.

Those wishing information may call Hugh Takagi or Hirochika Katayama at (202) 965-2993 with questions about potential Japanese buyers, quality, technology, tariffs, non-tariff barriers, and other trade-related problems.

A second office, located in the Seattle, Wash., office of the Japan Deep-sea Trawlers Association opened in January. The U.S. fishing industry is invited to take advantage of these facilities which were agreed to by U.S. and Japanese fishery officials last July. They were part of U.S.-Japan negotiations on fisheries trade, as mandated by the Magnuson Act and the amendments made to it in 1980.

Japanese Tell Overseas Fisheries Aid, 1973-83

Japanese Government sources report that at least US$64 million was used for fishery grants, loans, and scientific cooperation in 1982 (US$1.00 averaged 249 yen during 1982). However, the exact amount of Japanese aid to foreign countries in 1982 is not known because some fisheries assistance is a small component of agricultural projects or other assistance programs and is thus difficult to identify.

The Japanese Ministry of Foreign Affairs granted over $28 million in 1982 to foreign governments, mostly for the purchase of fisheries equipment. The Foreign Ministry's budget for fisheries grants has increased from $11 million in 1977 to $33 million in 1983. Since the beginning of the grant program in 1973, grants have been divided about evenly among Asia, Micronesia, Africa, and Latin America. The Japanese Foreign Ministry, through the Japan International Cooperation Agency (JICA), also provides grants to foreign governments for fishery projects. These technical assistance grants accounted for an undetermined portion of JICA's total $95 million budget in 1982 (which also included nonfishery assistance).

The Japanese Overseas Fisheries Cooperation Foundation (OFCF), which is funded by the Japan Fisheries Agency, provides indirect loans to a foreign government (or company) through Japanese joint venture partners. The OFCF loaned $37 million in 1982, and was authorized to loan almost twice as much ($63 million in 1983).

The Japan Marine Fishery Resource Research Center (JAMARC), a semi-governmental organization, also provides fisheries aid, though JAMARC primarily conducts research for the Japanese fishing industry. JAMARC provides scientific information on fisheries to foreign countries and involves foreign scientists in its research, especially work conducted off their countries. The U.S. Embassy in Tokyo has prepared a 15-page report surveying Japanese overseas fisheries aid during 1973-83. U.S. companies can obtain a copy of this report for $7.00 by ordering report number PB84-108661 from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161. (Source: IFR 83/129.)

Peru Explores Squid Fishing

The Peruvian Ministry of Fisheries (MIPE) and private fishermen began exploratory squid fishing last year for the first time. MIPE has obtained assistance from both FAO and Japan for the project. FAO provided a $158,000 grant which enabled MIPE to purchase fishing gear and hire Japanese squid fishing experts.

The goals of the MIPE project include utilizing idled anchovy boats, learning squid fishing methods, determining the economic viability of the fishery, identifying the most profitable squid products to produce, and increasing export earnings. MIPE is especially interested in utilizing species not taken by Peruvian fishermen and officials stress that their major concern is to acquire the necessary fishing technology. MIPE points out that the Japanese have a large fleet involved in the squid fishery and personnel with extensive experience. For those reasons, MIPE has been particularly eager to obtain Japanese technical assistance.

MIPE signed a contract with Peruvian vessel owners and loaned the fishermen funds needed to purchase automatic fishing gear, auxiliary motors, shipyard services, and various equipment so the anchovy boats could be fully equipped for exploratory squid fishing.

Tuna Fishing Off Ecuador Picks Up

Ecuadorean officials report that tuna have returned to Ecuadorean coastal waters and hope that this may signal a revival of the country's depressed tuna industry. Many believe that tuna fishing

was poor during the 1982-83 season because of the unusually warm water associated with the El Niño phenomenon.

Industry sources report that tuna schools appeared in Ecuadorean waters during November, earlier and in larger quantities than usual. Normally the tuna season off Ecuador does not begin until December, but already in November local fishermen were reporting excellent catches. The Ecuadorean tuna catch in November 1983 was 5,600 metric tons (t), a 60 percent increase over the 800 t taken during the same period of 1982. Most of the fishing was south of Salinas, about 50-60 miles off the coast, and the predominant species landed was skipjack tuna. Fishing was so good that one small Ecuadorean tuna seiner reportedly capsized because it tried to land too many fish. Reports from Manta, Ecuador's principal tuna port, indicate that cold stores were filled and that canneries were running at full capacity. Fishermen were also experiencing delays in unloading their catch because of the lack of space available in Manta's cold stores.

Ecuadorean fishermen operate from Costa Rica to Peru. During October 1983, several Ecuadorean fishermen were operating off Peru in an area claimed by both Peru and Ecuador. Peruvian authorities reportedly seized nine Ecuadorean and one Mexican seiner during November. A second Mexican seiner was reportedly detained by Ecuador, but not seized. Most of the Ecuadorean seiners were small "bolicheras." The vessels were taken to the port of Talara and fined from $2,500 to $102,000 per vessel. The two largest fines were to the *Don Cesar* ($102,000) and the *Clemenza* ($47,000).

The improved fishing was welcome news for the Ecuadorean tuna industry. Many pressing problems, however, continued to plague local tuna companies. First, prices on the international market were depressed. Second, companies have been unsuccessful at resuming sales to the United States, even though the U.S. tuna embargo had been removed. Third, import controls in Venezuela, resulting from that country's balance of payments difficulties, had restricted sales to one of Ecuador's primary export markets. (Source: IFR-83/139.)

Icelandic Cod Stocks Decreasing

Iceland's cod catch through September 1983 totaled only 252,000 metric tons (t), compared with 326,000 t for the same period in 1982. The total 1982 catch of 382,000 t was itself much less than the 1981 total of 460,000 t and Icelandic scientists recommended a TAC of only 200,000 t for 1984. However, it is expected that the Icelandic fishing industry will have to take about 250,000 t to remain economically viable.

Some observers believe that the decreased cod catch in 1982 and 1983 has been caused by the overfishing of capelin on which cod feeds. The Icelandic Government banned all capelin fishing in July 1982, but the measure apparently came too late and the decreased capelin biomass is now affecting cod populations. U.S. cod imports, however, are not affected, for the time being. Iceland's cod exports to the U.S. through September 1983 totaled 22,846 t, down only 98 t from such exports for the same period in 1982. One probable reason is the high value of the U.S. dollar (compared with other European currencies).

Peruvian Catch of Finfish Plummets

The impact of the 1982-83 El Niño in the eastern Pacific is clearly shown by the disastrous catch reported by Peruvian fishermen. Press reports from Lima revealed that Peruvian fishermen caught only 184,000 metric tons (t) of fish in the second quarter of 1983, a 64 percent decline from the 512,000 t taken during the first quarter of the year. Peruvian fishermen usually take most of their annual catch in the first 6 months of the year.

Unless catches improved later, Peru could report a 1983 fisheries catch below 1 million t, which would be a decline of over 70 percent from the 3.5 million t taken in 1982. It would be the smallest catch reported by Peru since the country developed a major fishmeal industry in the 1960's. Fishermen report that anchovy, once the mainstay of the fishing industry, had virtually disappeared. The Marine Fisheries Institute (IMARPE) recommended closing the anchovy fishery for up to 5 years.

However, the abnormally warm water off Peru has apparently caused an increase in scallop catches. Several companies have reportedly leased unused government processing facilities in Pisco and planned to export to the United States. One U.S. fisherman was reportedly conducting experimental scallop fishing under contract with a local company late in 1983.

Mexican Tuna Catch, 1983

Arturo Zepeda Vazques, President of the Mexican National Fishing Industry Board, has stated that Mexico's 1983 tuna catch (Jan.-Sept.) totaled only 20,000 metric tons (t), down 40 percent from the 35,000 t taken during the same period in 1982. Zepeda said this represented a loss of 1.8 billion pesos to Mexico's tuna industry.

Zepeda believes that the primary cause of the decline was El Niño. Other problems, however, have also affected the Mexican tuna fishery. Mexico's fishermen have had trouble selling their tuna landings and some reduced their fishing effort. In addition, domestic production costs had been rising at a rapid rate.

The West African Fisheries Conference

Under the auspices and the encouragement of the European Economic Community (EEC), a ministerial-level conference was held in Libreville, Gabon, last November to discuss the establishment of a regional fisheries organization for the countries along the Gulf of Guinea. Participating were representatives of the Congo, Equatorial Guinea, Gabon, Sao Tome and Principe, and Zaire. The conference focused on a comprehensive fisheries study of the Gulf of Guinea recently completed by the EEC. The EEC study included estimates of fishery resources, maximum sustainable yields, and a proposal for several regional cooperation and development programs.

The main accomplishment of this first conference was the opening of a dialogue on fisheries among the countries bordering the Gulf. The participants agreed that the main primary objectives are the harmonization of national fishing regulations and the management and control of fishing operations. The participants also agreed on three projects to promote fisheries which were originally proposed in the EEC study:

1) Establish a marine fisheries research center at Pointe Noire, Congo.

2) Create a regional school for marine fisheries at Cap Esterias, near Libreville, and purchase a fisheries training vessel from the EEC to enable the students to gain practical experience.

3) Establish an artisanal fishing center which would include the necessary infrastructure such as an ice plant and a repair shop for small boat motors.

The EEC is reportedly willing to provide substantial technical assistance to the Gulf of Guinea countries, most of which are former colonies of EEC-member countries. The EEC is promoting the establishment of the new organization and, at the request of the participating countries is making recommendations on how it could be organized as well as on how it should function.

The EEC was to submit a formal proposal on the new organization for the approval of the participating countries by 31 May 1984. A second meeting is expected shortly thereafter to take the next step in establishing the organization. (Source: U.S. Embassy, Libreville.)

EEC-CANADIAN FISHING AGREEMENT

In January 1982, an agreement between the European Economic Community (EEC) and Canada was signed that gave Canada preferential duty rates for imports into the EEC in return for EEC fishing rights in Canadian waters. The agreement period was to have run from 1 January 1982 to 31 December 1987. However, Canada suspended issuance of fishing licenses to the EEC early in 1983 in response to what Canada termed as nonabidance of the 1982 agreement.

The United Kingdom (UK), Canada's largest EEC importer of Canadian products, objected to the large volumes of Canadian cod entering the UK market at reduced tariff rates. The UK reduced the amount of Canadian cod allowed to enter the UK at the preferential rate to a 10 percent share of the total negotiated cod quota. Canada looked upon this as an effort to keep them out of the UK market.

The EEC Canadian agreement of 1982 has now been renegotiated with the following results: In return for a better access to EEC markets where Canadian fisheries products will benefit from significantly lower import duties on frozen seafoods, EEC fishermen will be allowed to fish in Canadian waters until 1987 with the following yearly limits: 1984, 19,000 t; 1985, 20,000 t; 1986, 22,000 t; and 1987, 24,000 t.

Polish Squid Catch Leaps

Polish press reports indicate that the Polish squid catch totaled 120,000 metric tons (t) in 1982, a 600 percent increase over the 20,000 t taken in 1981. Almost all of the catch was landed in the southwest Atlantic off Argentina. Argentine exporters have demanded that their Government reduce the Polish fishing effort because the Polish catch has affected squid prices on world markets.

In response, the Argentine Government has cancelled the special transshipping rights granted to Polish vessels during the 1982 Falklands crisis, when the Polish Government supported the Argentine position. The Argentine Government, however, has been unable to reduce the Polish fishing effort because it is mostly conducted outside Argentina's 200-mile Territorial Sea, or in the British-controlled 150-mile exclusion zone around the Falklands.

U.S. Trade Missions Aid Overseas Seafood Sales

A variety of U.S. Trade Missions have been scheduled by the Foreign Agricultural Service (FAS), U.S. Department of Agriculture, in several foreign nations to promote U.S. food exports. In June 1984 FAS has sponsored the Kor-Hotel Food Exhibit in Seoul, Republic of Korea, featuring institutional food and U.S. seafood companies so oriented were invited to participate. Further details are available from Evans Brown, Export Programs Division, FAS, USDA, Room 4945, South Building, Washington, DC 20250. And, in September, FAS was coordinating a food product display in Caracas, Venezuela. More information is available from William Scholz, Export Programs Division, FAS. Also in September, FAS was organizing a food exhibit in Port of Spain, Trinidad and Tobago, and the contact again is William Scholz. For the FAS September food exhibit in Lagos, Nigeria, seafood firms may contact Evans Brown for further information. The telephone number for both Scholz and Brown is 202-447-3031.

Thailand's Fisheries Trade Rises in 1982

Thailand reported that 1982 fishery exports increased in value by 17 percent over 1981, from $416 million to $487 million (Table 1). In quantity, exports increased only 1 percent over 1981 to 323,400 metric tons (t). Shellfish accounted for over half of all exports, with shrimp and cuttlefish the principal commodities. Thailand's major markets, Japan ($169 million) and the United States ($71 million), took nearly 50 percent of the exports (Table 2). Principal U.S. imports were canned fish and frozen shellfish (Table 3).

Thailand's 1982 fishery imports increased by 22 percent in value over 1981, but decreased slightly in quantity (3 percent), mainly because fewer

Table 1.—Thailand's foreign trade in fish and fishing products, 1981-82.

Item	1981		1982	
	Metric tons	U.S. dollars[1]	Metric tons	U.S. dollars[2]
Fishery imports				
Fresh, frozen and live fish	11,329.7	9,490,559	14,255.9	14,916,222
Salted, dried and smoked fish	528.0	1,997,479	237.3	2,259,329
Crustaceans and mollusks, fresh, frozen, dried, salted, and cooked	27,185.0	8,571,173	21,812.3	8,409,614
Canned fish and fish preparations including crustaceans & mollusks	257.4	356,829	731.0	717,666
Fish and fish preparations, preserved but not canned, including crustaceans & mollusks	7,762.8	1,729,148	8,686.8	1,762,029
Total	47,062.9	22,145,188	45,723.3	28,064,860
Fishery Exports				
Fresh, frozen and live fish	57,436.5	37,235,472	53,695.1	31,829,970
Salted, dried and smoked fish	3,488.7	4,847,525	2,875.6	4,363,774
Crustaceans and mollusks, fresh, frozen, dried, salted, and cooked	71,532.3	200,420,761	86,147.1	248,768,750
Canned fish and fish preparations including crustaceans & mollusks	44,194.6	98,152,200	66,000.9	138,454,572
Fish and fish preparations, preserved but not canned, including crustaceans & mollusks	143,018.8	74,995,784	114,653.0	63,268,990
Total	319,670.9	415,651,742	323,371.7	486,686,056

[1]Conversion rate, 21.82 Baht =US$1.
[2]Conversion rate, 23.00 Baht = US$1.

Table 2.—Thailand's fisheries imports and exports by country (1982) and value (in $US).

Country	Value
Imports	
Burma	$7,945,659
Malaysia	5,155,624
Maldives	3,706,353
Japan	2,409,448
Hongkong	2,037,253
U.S.A.	1,299,871
Singapore	1,115,116
Bangladesh	666,493
Australia	652,982
Rep. of Korea	443,856
Norway	372,593
Philippines	287,028
United Kingd.	238,050
Canada	152,426
Others	1,415,751
Total	$28,228,725
Exports	
Japan	$168,646,346
U.S.A.	71,317,721
France	33,442,265
Italy	28,122,255
Hongkong	26,346,404
Australia	24,607,633
Malaysia	21,478,004
Singapore	20,661,129
W. Germany	17,264,642
United Kingd.	15,134,466
Indonesia	8,640,739
Netherlands	7,735,083
Sweden	6,005,449
Canada	5,018,065
Belgium	3,597,466
Nigeria	2,419,328
Sri Lanka	2,388,515
Denmark	2,386,967
Spain	2,146,630
Saudi Arabia	2,073,427
Others	17,253,522
Total	$486,686,056

Table 3.—Thailand's fisheries exports to the United States, 1982.

Commodity	Volume (t)	Value (US$)
Fish preserved in airtight containers	12,237.5	$28,479,834
Crustaceans, mollusks prepared or preserved in airtight containers	5,211.7	16,566,751
Shrimps, prawns, lobsters fresh, chilled, frozen	3,699.4	15,270,202
Fish sauce	3,779.7	2,558,578
Flours and meals of crustaceans or mollusks	2,273.5	2,088,442
Other fish, frozen	627.6	1,541,557
Shrimps, prawns, lobsters salted in brine, dried	229.3	1,276,220
Other fish fillets, fresh, chilled	308.0	725,930
Cuttlefish salted in brine, dried	75.5	488,962
Other fish dried	101.8	384,138
Other crustaceans, mollusks, fresh, chilled, frozen	90.2	307,341
Other fish preserved not in airtight containers	112.8	343,598
Fish live for aquarium	64.1	256,483
Cuttlefish fresh, chilled, frozen	135.4	181,635
Ark-shells fresh, chilled, frozen	131.2	178,670
Cuttlefish not in airtight containers	6.6	73,320
Fish maws and roes dried, smoked	5.0	73,299
Other crustaceans simply boiled	30.5	62,493
Other fish fresh, chilled	24.9	57,368
Fish salted or in brine	12.8	43,104
Blachan not in airtight containers	18.2	42,087
Fish, live	15.2	35,605
Other crustaceans, mollusks salted in brine, dried	15.2	34,078
Shark's fins not in airtight containers	11.0	32,068
Fish smoked	3.5	30,342
Blachan in airtight containers	13.6	27,987
Crabs, crab meat fresh, chilled, frozen	15.6	26,039
Other crustaceans, mollusks prepared or preserved, not in airtight containers	3.8	17,723
Octopus salted in brine, dried	2.4	16,937
Jellyfish salted in brine, dried	6.7	16,307
Cuttlefish in airtight containers	7.3	14,062
Fish maws, roes in airtight containers	4.5	12,337
Fish maws, roes not in airtight containers	2.8	12,052
Oyster sauce	2.8	8,933
Other fish fillets frozen	2.9	6,517
Squids salted in brine, dried	0.6	6,514
Shrimps, prawns, lobsters simply boiled	1.9	5,978
Asari fresh, chilled, frozen	6.5	5,594
Other items	2.5	7,626
Total	29,293.9	$71,317,721

shellfish were imported. Thailand imported almost $1.3 million worth of Fishery products from the United States during 1982. (Source: IFR-83/140.)

South African Marine Fisheries Changing

The overall South African fish catch and production of fishery products during 1982 continued at about 1981 levels. Recent changes in the government's pelagic fishery management program, however, have been controversial and were expected to affect the fishing industry in 1983.

The demersal fish catch was 195,500 t in 1982, an increase of 5 percent from 1981 and a reversal of the previous 2 years of decreases. Hake accounted for 73 percent (142,800 t) of the total demersal catch. Fish meal production was maintained at 1981 levels, but there was a sharp decrease in fish oil production.

South Africa has restricted foreign fishing off its coast in recent years. The government has only authorized a few countries (Japan, Taiwan, Israel, and Spain) to take small quantities of certain species (predominantly hake) within South Africa's 200-mile exclusive fishery zone during 1982.

The 1982 pelagic fish catch of 377,000 metric tons (t) was based almost entirely on anchovy (306,160 t or over 80 percent of the total pelagic catch). Fishermen reported a decline in the pilchard and horse mackerel fisheries, and changes made by the South African Government in the pelagic fishing seasons and catch quotas to avert a collapse of the resource were not well accepted by the fishing industry.

South Africa's west coast pilchard catch decreased from 318,000 t in 1960 to only 35,000 t in 1982, but the anchovy catch increased from 300 t in 1963 to 307,00 t in 1982. Indications were that too many juvenile fish were being taken in the anchovy fishery, as occurred in the pilchard fisheries in the past, according to the Department of Environmental Affairs and Fisheries (DEAF).

The following changes began with the 1983 fishing season:

1) The season for anchovy and pilchard was divided into two periods. The first half began 1 January and was to last until half the 1983 quota of 380,000 t (190,000 t) had been caught. The second phase of the season began 1 October and lasted until 15 December.

2) Beginning in 1983, the pilchard catch can be used only for canning and not for reduction to fish meal.

3) Underutilized pelagic fishes (herring, lantern fish, mackerel, and maasbanker) did not have catch quotas in 1983.

4) Deep-sea hake quotas for 1983 were reduced from 136,000 t to 120,000 t (coastal trawler catch reduced from 9,000 to 7,940 t; deep-sea trawler catch reduced from 119,150 to 105,135 t; and foreign trawler catch reduced from 7,850 to 6,925 t). South Africa's Navy has helped patrol fishery grounds to prevent illegal foreign fishing.

The Fisheries Department also recommended a change from the January-August catching season for anchovy and pilchard to provide the fish a 6-month period to mature and spawn; too many juvenile fish were being taken before sexual maturation under the previous arrangement. DEAF decided not to decrease the pelagic fish quota below 380,000 t because it believed such a move would adversely impact private vessel owners and might lead to increased fish meal prices.

John Wiley, Deputy Minister of DEAF, in announcing the changes, said that the "New Deal" could succeed only if the industry is prepared to accept responsibility for honestly monitoring their own catches and fully cooperating with DEAF to ensure that quotas are not exceeded and irregularities are corrected.

Then, on 2 September, Wiley announced new measures to control the country's endangered pelagic fishery resources. Wiley said that the Government accepted most of the recommendations made by the Alant Commission of Enquiry. After discussions with all interested parties, he felt that he had the support of the fishing industry.

The 1984 fishing season was scheduled to begin on 15 January. Wiley said that the introduction of a two-phase seasonal quota system as a new control measure should limit the anchovy catch to 15,000 t in the coming season in the area east of Cape Point. Of this, west coast registered boats would be limited to 8,000 t and Gansbaai fishermen on the east coast to 7,000 t. He warned against catching pilchards and said that private boat owners and quota holders should cooperate. There would be no specific quotas for fishing off the west coast. The Government will monitor mackerel, red eye, maasbanker, lantern fish and anchovy, however, on a weekly basis to ensure that there are no excessive catches. Once sufficient fish are caught, the season will be closed immediately. Such a decision will be made, however, only after extensive research is done during the season, Wiley stated.

Wiley also announced the closure of all fishing in Walker Bay, in a straight line from Mudge Point to Danger Point, as an experimental measure. The area would become a sanctuary like False Bay, with no fishing permitted. Gansbaai fishermen will have to fish further afield, east of the Cape Point area.

The U.S. Consulate General in Cape Town has prepared a 16-page report on the South African fishing industry in 1982. U.S. companies can obtain a copy of this report for $7.00 by ordering report number PB 83-242-479 from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161. (Sources: IFR-83/20, 98, 101.)

Note: Unless otherwise credited, material in this section is from either the Foreign Fishery Information Releases (FFIR) compiled by Sunee C. Sonu, Foreign Reporting Branch, Fishery Development Division, Southwest Region, National Marine Fisheries Service, NOAA, Terminal Island, CA 90731, or the International Fishery Releases (IFR), Language Services Biweekly (LSB) reports, or Language Services News Briefs (LSNB) produced by the Office of International Fisheries Affairs, National Marine Fisheries Service, NOAA, Washington DC 20235.

Canada Restructures Newfoundland Fishery

The Canadian Federal Government and the Provincial Government of Newfoundland reached an impasse in late summer on plans to restructure the Newfoundland fishing industry. Federal and provincial officials had been discussing the restructuring of the Province's fishing industry since Canadian Federal Fisheries Minister, Pierre de Bane, announced a Federal restructuring plan on 19 July. De Bane announced that the Canadian Federal Government would unilaterally reorganize the Newfoundland deep-sea fishing industry by creating a new "super-company." The Minister indicated that the new company would be formed around a merger of three Newfoundland fishing companies, Fishery Products Ltd.[1], the Lake Group Ltd., and John Penny and Sons Ltd. Financing of the company was reportedly to be partially met, with C$75 million[2] in financing from the Canadian Federal Government.

Federal restructuring plans were delayed, however, by the Bank of Nova Scotia. The Bank placed two of the fishing companies, which were to form the new super-company, Fishery Products Ltd. and the Lake Group Ltd., in receivership during August. Shareholders of the third company, John Penny and Sons Ltd., had previously voted to dissolve the company and place it in voluntary liquidation. Fishery Products Ltd. was resisting the takeover by the Bank and took the matter to the Provincial Supreme Court on 1 September. In court, company officials alleged that the Bank of Nova Scotia contravened antimonopoly laws and, furthermore, conspired with the Canadian Federal Government to take possession of its assets.

Newfoundland's Premier Brian Peckford, at a press conference then, criticized the Bank's actions. He stated that as a result, the Bank of Nova Scotia had only two options open to it because of the receivership actions. The Bank would have to eventually sell the assets of the companies, either by private sale, or public bidding. Premier Peckford said that the Province was seriously considering buying the assets of the three major companies in order to deflect "others from outside the Province now attempting to take full control of the fishing industry of Newfoundland and Labrador." (Source: IFR-83/89.)

[1]Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

[2]During August 1983 the Canadian dollar traded for about US$0.85.

Western Atlantic Turtle Symposium

The Western Atlantic Turtle Symposium (WATS) was held in San Jose, Costa Rica, 17-23 July 1983. The Symposium was sponsored by the International Oceanographic Commission Association for the Caribbean and Adjacent Regions (IOCARIBE), with support by NMFS, the Food and Agricultural Organization of the United Nations, the Canadian International Association, and 36 of the 38 countries in the WATS region. Topics discussed included: Status of Turtle Species, Research Techniques, Habitat Alteration Impacts, Utilization, Conservation, Culture, Enforcement and Regulation, and Management Options.

The first product of the Symposium was "Sea Turtle Manual of Research and Conservation Techniques." The second product was the "National Report Form," a volume of instructions and 21 tables for recording available sea turtle data for each of the countries. The third product was the "WATS Computerized Data Base."

The final session, "Future Actions," was chaired by the President of WATS, Manuel Murillo, and conducted by the national representatives. They recommended that the initiative of WATS be continued, and that WATS-II convene in 1987. The National Marine Fisheries Service will serve as caretaker for the data base until a permanent agent is assigned.

A WATS Steering Committee, formed in 1979, consisted of the following members: Manuel Murillo, President; Robert Lankford, Administrator; Fred Berry, Secretary; and Peter Bacon, Harvey Bullis, Archie Carr, Jorge Carranza, Colin Higgs, Herb Kumpf, Hank Reichart, and Horace Walters. Also, a Technical Team was formed to promote and aid sea turtle research, survey, and data gathering. Team members included: Larry Ogren, Coordinator; Karen Bjorndal, Ken Dodd, John Fletemeyer, Juan Gonzalez, Rene Marquez, Anne Meylan, Peter Pritchard, Doon Ramsaroop, Jack Woody, and six members of the Steering Committee. Marie Teresa Koberg guided local preparations for the meeting.

In 1980, the IOCARIBE Secretary and Administrator of WATS contacted the appropriate Ministers of the 38 area countries, requesting that each country officially participate in the Symposium effort, designate a national representative to the Symposium, and prepare a national report on the populations and socioeconomics of sea turtles.

Sea turtle research, stimulated throughout the area during 1980 through June 1983, consisted of interviews, nesting beach, and aerial beach surveys. The goal of conducting at least one aerial beach survey for the entire shoreline of the Atlantic continental Americas, from North Carolina to Brazil, was 99 percent completed. Several of the larger islands were also surveyed.

At the Symposium, 31 national representatives participated, representing 33 countries. The participating countries were: Anguilla, Antigua, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Colombia, Costa Rica, Dominica, Dominican Republic, French Guiana, Grenada, Guadalupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Nicaragua, Panama, Puerto Rico, St. Kitts-Nevis, St. Lucia, St. Vincent, Surinam, Trinidad-Tobago, Turks-Caicos, U.S. Virgin Islands, United States of America, and Venezuela. (Source: IFR-83/107.)

Pollock or Cod: Can the Difference Be Told?

The pollock, *Pollachius virens*, is a good source of protein which can often be processed and prepared in recipes that call for Atlantic cod, *Gadus morhua*, or haddock, *Melanogrammus aeglefinus*. The pollock is similar in flavor, odor, and texture to both cod and haddock, yet is not a popular catch among coastal water fishermen who often equate it with poor quality and throw it back.

The pollock is a relative of the Atlantic cod but is usually smaller, averaging 4-12 pounds compared with the cod's average of 10-22 pounds. Also, coastal-water caught pollock may be smaller yet. Although nutritional values are very similar (Table 1), our April 1983 survey of several fish markets in the Boston-Gloucester, Mass., area showed pollock costing an average of $0.50 per pound less than cod.

Thus, we designed a study to see if the general public could distinguish between Atlantic cod and pollock prepared in three recipes (Table 2). Those tasters who could distinguish a difference were then asked to give their preference.

Tasters for this study were volunteers who attended an Open House at the Essex Agricultural and Technical Institute in Danvers, Maine, 30 Apr.-1 May 1983. Volunteers varied in sex, age, and ethnic origin. The tests were conducted, and the samples prepared, by students of the Institute's Food Science and Nutrition Program. Fish used for the taste tests were donated by a commercial fish processor in the form of frozen fish fillet blocks. Recipe samples were prepared as in Table 3 for Gloucester Sea Puffs, Fishwiches, and Fishcakes.

The triangle test was used, with each taster given three samples of a particular recipe (Table 2). Two like samples were prepared using cod, one sample was prepared with pollock, or vice versa. The tasters were asked to identify the two like samples and then give their preference of either the like pair or the odd sample. Tasters marked their results on score sheets which were returned for tabulation (Fig. 1). To avoid chance selection of the odd sample, samples were served in the order shown in Table 4, thus lowering to one-third the probability of chance selection of the odd sample.

The results of the 2-day test are given in Table 5. More than 60 percent of the tasters failed to identify the like samples of Fishwich and Fishcake, and nearly half of the tasters failed to identify the like samples of Gloucester Sea Puffs. About 50 percent of those tasters who correctly identified the like pairs of Fishwich and Fishcakes preferred pollock over cod.

Our conclusion is that pollock may be successfully substituted in these recipes with very little difference in quality and taste. In fact, in the case of the Fishwich, pollock seems to make the product even more desirable to tasters. We hope these results can help encourage consumers to request pollock from fresh fish retailers and thereby make it

Table 1.—Nutritional values of cod and pollock (per 100 g)[1].

Item	Cod	Pollock
	Values	
Protein (g)	17.6	20.4
Fat (g)	.3	.9
Carbohydrates (g)	0	0
Sodium (mg)	70	48
Potassium (mg)	382	350
Water (g)	81.2	77.4
Calories	78	95

[1]Source: U.S. Department of Agriculture, 1973.

Table 2.—Test recipes[1].

Gloucester Sea Puffs

1¼ pounds fish	3 medium eggs
2½ cups self-rising flour	½ tsp. black pepper
2 tbsp. chopped parsley	1¼ cups milk
2 cloves minced garlic	4 cups vegetable oil

Cut fish into 5-inch strips ¼-½ inches thick. Season lightly with salt and set aside. Beat eggs well, add milk, and mix well. Combine flour, parsley, garlic, and pepper. Add to egg and milk mixture. Mix well. If batter is too thick, add a little more milk. Heat vegetable oil to boiling point in heavy pan or Dutch oven. Dip fish pieces in batter until well covered. It may help to stir with a large spoon. Brown pieces in oil; they will float. Turn them over to brown evenly, drain on paper towels. Puffs can be frozen and reheated in hot oven.

Fishwiches

1 cup cooked fish	¼ cup mayonnaise
¼ cup chopped celery	2 tbsp. catsup
1 tsp. chopped parsley	salt and pepper

Mix the first five ingredients together and salt and pepper to taste. Then spread between slices of bread. Can also be served on crackers or used as a sandwich filling.

Fishcakes

1 pound fish	1½ cups diced potatoes
1 cup bread crumbs	¼ cup grated parmesan cheese
2 large cloves garlic, finely chopped	1 tsp. parsley flakes
1 tsp salt	dash pepper
cooking oil	2 eggs

Cover potatoes with water and bring to boil. Add fish and continue boiling until potatoes are tender and fish flakes easily. Drain, cool for 10 minutes, and mash. Add crumbs, cheese, garlic, parsley flakes, salt, pepper, and eggs. Mix well. Shape into cakes and fry in cooking oil at 375°F until brown. Drain on absorbent paper.

[1]Source: The Fishermen's Wives of Gloucester, 1976.

Table 3.—Sample preparation.

Gloucester Sea Puffs
1. Frozen fish blocks were cut into about 1 × ½ × ½-inch pieces.
2. Fish pieces were rolled in the flour mixture and dipped in the batter.
3. Dipped pieces were drained briefly to remove excess batter and placed on cookie sheets lined with freezer wrap.
4. Coated pieces were frozen at −20°F and then packed in 1-pound batches in polyethylene freezer bags.
5. Bags were held in the freezer at 0°F until preparation.
6. Frozen puffs were fried in soybean oil at 375°F until golden brown (about 90 seconds) prior to serving.

Fishwiches
1. Frozen fish blocks were thawed at 40°F and cooked in steam-jacketed kettles.
2. The fish was cooled and packed in polyethylene bags with enough celery, parsley, salt, and pepper for a double recipe, and held at 40°F until ready for use.
3. Before serving, mayonnaise and catsup were added and the salad was made.
4. Salad was served on round crackers.

Fish Cakes
1. Frozen fish blocks were thawed at 40°F and the cakes were prepared and fried according to the recipe.
2. Fish cakes were cooled and wrapped in a clear plastic food wrap, boxed, and stored at 40°F.
3. Prior to serving, the fish cakes were reheated in a convection oven at 325°F for 15-20 minutes.

Two of the samples are identical and the other different. Please check the duplicate samples and score your preference for either the identical or odd samples.

SCORING: Designate whether you prefer the pair or the odd sample by (P).

Sample #	*Identical samples (indicate by check mark)*	*Score*
______	______	______
______	______	______
______	______	______

Plate # ______ Date ______

Figure 1.—Sample score sheet.

Table 4.—Serving guide for triangle test.

Plate #	Product	Arrangement of pollock (P) and cod (C) on test plate
1	Fishwich	P P C
2		P C P
3		P C C
4		C P C
5		C C P
6		C P P
7	Sea Puffs	P P C
8		P C P
9		P C C
10		C P C
11		C C P
12		C P P
13	Fishcakes	P P C
14		P C P
15		P C C
16		C P C
17		C C P
18		C P P

Table 5.—Test results.

Recipe	Total	Correct	Incorrect	Preference Cod	Preference Pollock
Fishwich	168	65	103 (61%)	17	24 (59%)
Sea Puffs	190	97	93 (49%)	46	28 (38%)
Fishcakes	119	45	74 (62%)	17	15 (47%)

more profitable for coastal water fishermen to keep and utilize their pollock catches.

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All-Tackle Angling Records Are Expanded

The International Game Fish Association (IGFA) has announced the revision and expansion of its all-tackle world record program by opening it to game fishes not currently on its record lists (past catches included) and by reviewing well-documented applications for past catches that exceed its current listings.

All-tackle records are maintained for the heaviest fish of a species caught according to IGFA angling rules on any line up to 60 kg (130-pound) class. The listings are being expanded to recognize catches of species which, though popular in various fishing areas, have never been documented in a world record program. The evolution of the all-tackle program to date has also excluded recognition of past catches in instances where new species have been added over the years.

Late last year IGFA began accepting applications for "all-tackle" recognition of species whether or not they were included among the world record species in the association's "1983 World Record Game Fishes" book. This applies to both freshwater and saltwater fishes. Catches made after 1 January 1984 must be in accord with current IGFA angling rules and world record requirements. The angler must complete the IGFA world record application form in its entirety and submit the required data and information.

For catches made in the past, as much information as possible must be submitted on an IGFA world record application form with additional substantiating data. Acceptable photographs must be submitted, the weight of the fish must be positively verified, and the method of catch must be substantiated.

Applications for "new species" must conform to the following requirements in addition to published IGFA rules:

1) The fish must represent a valid species with a recognized scientific name.

2) The fish must be a species commonly fished for with rod and reel in the general area where the catch is made.

3) The fish must be identifiable based on photos and other supporting data presented with the application.

4) The fish must be considered "trophy-sized." A rule of thumb will be that the weight must fall within the top half of the estimated maximum weight of the species. (The minimum weight requirement for any IGFA record is 1 pound or 0.45 kg.)

All-tackle record applications for "new species" will be accepted throughout 1984, and the first new listings of all-tackle records will be announced in January 1985, at which time appropriate certificates will be issued for the largest approved catches. Entries in IGFA's Annual Fishing Contest (including validated entries from past years) will also be considered for all-tackle recognition. No new species will be recognized or added to the record system during the calendar year of 1984.

All-tackle record applications for species currently included in IGFA's record program will be processed and

awarded during 1984. Decisions by IGFA's Executive Committee regarding acceptance or rejection of record claims will be final.

"We are undertaking this revised and expanded record program," said IGFA President E. K. Harry, "in order to recognize all sport fish of interest to anglers worldwide and so that our all-tackle listings will truly reflect the heaviest catches made in a sporting manner on rod and reel, whether past or present." A current copy of IGFA world record rules and requirements is available for US$1 to cover cost, postage, and handling from IGFA, World Record Department, 3000 East Las Olas Blvd., Ft. Lauderdale, FL 33316-1616. (Source: IGFA.)

USITC to Investigate Northeast U.S. Scallop, Groundfish Industries

At the request of the United States Trade Representative (USTR), the U.S. International Trade Commission has instituted investigation 332-173 to gather and present information on the competitive and economic factors affecting the performance of the Northeastern U.S. groundfish and scallop industries in selected Northeastern U.S. markets and will analyze these industries' competitive position in these markets. Specifically, the Commission has been asked to develop the following information, with an emphasis on, but not limited to, the Canadian and U.S. industries: Government assistance to the fisheries industries; fisheries resources and their trade; industry integration; employment; product prices, financial structure of the harvesting and processing industries; the effect of exchange rates and tariff and nontariff barriers on the flow of trade between the two countries; the importation of other product types, like frozen fish blocks; and trade barriers of other potential Canadian export markets.

The USTR requested on 8 November 1983, that the Commission investigate the competitive conditions affecting the performance of the fishing industry in the Northeastern United States. The USTR specified that the investigation should cover fresh and frozen whole groundfish (cod, haddock, pollock, flounder, and sole), groundfish fillets, and scallops and that the study should concentrate on the industries and markets of the New England and Middle Atlantic States. To the extent possible, the study will provide information on the distinct markets for each of the groundfish species and the interaction between U.S. imports and the operations of U.S. harvesters, processors, and importers. The USTR also requested that emphasis be placed on an analysis of industry conditions in Canada and U.S. imports from that country.

A public hearing for the investigation will be held on 5 September 1984, in Boston, Mass., and on 7 September 1984, in Portland, Maine. At least 60 days before the hearings, a *Federal Register* notice will be posted giving the exact times and locations. All interested persons may present information and be heard. Requests to appear at the public hearing should be filed with the Secretary, U.S. International Trade Commission, 701 E Street NW, Washington, DC 20436, by noon, 29 August 1984.

In lieu of or in addition to appearances at the public hearing, interested persons are invited to submit written statements concerning the investigation at the earliest practical date, but not later than 22 August 1984. All submissions should be addressed to the Secretary at the Commission's office in Washington, D.C. Further information is available from Doug Newman or Tom Lopp, Agriculture, Fisheries, and Forest Products Division, U.S. International Trade Commission, Washington, DC 20436.

Louisiana Fisheries Well Managed and Productive Report State Officials

Persistent charges by some environmental groups that Louisiana fisheries, including the important shrimp fishery, are declining in productivity because of improper management of those resources are false and unsubstantiated by fisheries statistics, according to the Louisiana Department of Wildlife and Fisheries. Jesse J. Guidry, department secretary, said that in 1981 Louisiana had led all of the other states in total fisheries poundage produced, with a catch of 1,168,579,000 pounds, representing 20 percent of the entire national catch. In 1982, total poundage was even greater. Louisiana produced 1,718,700,000 pounds.

Louisiana shrimpers, along with all American shrimpers, didn't catch as much shrimp as they did in 1981 which was the all-time record year for shrimp production in American waters. The catch in 1981 surpassed any previous catch since records have been kept. However, Guidry said, in 1982, for the third year in a row, the value of the shrimp catch went up. The national 1982 harvest returned $509.1 million to shrimpers at dockside, an increase of $45.9 million over 1981. The value of the catch set a record for shrimp, surpassing the value of the 1979 catch when 335.9 million pounds brought $471.5 million.

Guidry said that statistics released by the National Marine Fisheries Service showed that Louisiana shrimpers produced some 57 million pounds of heads-off shrimp in 1982 at state docks. This was less than the 71 million pounds produced in the all-time record year of 1981, but the dollar value to Louisiana shrimpers was $146 million, compared to 1981's $136 million. In reality, he said, this is where economics enters the seafood picture. The total catch was down 19 percent, but the smaller catch brought Louisiana shrimpers an extra $10 million more than the banner catch of 1981.

It is significant to note that during the past 5 years of shrimp production in Louisiana, three of those years have been progressively better record years. There were 66 million pounds of headless shrimp produced in 1977; 66.2 million pounds in 1978; making two back-to-back record years; and 71 million pounds in 1981.

Guidry said there is a rule of thumb in calculating the value of dockside shrimp landings to the overall

economic importance of the shrimp industry to the state. The dockside value of the catch is multiplied by three to provide a broad base. Consequently, the $146 million dockside value of the 1982 shrimp catch in Louisiana is projected to be a base $438 million segment of Louisiana's seafood economy. When oysters, crabs, menhaden and finfish values are added, we are looking at a half-billion dollar seafood industry, he added. Contrary to unsubstantiated statements by some groups, Louisiana's fisheries resources have never been more productive and this certainly reflects sound and wise management of those resources, Guidry concluded.

Lobster and Crab Bait Studied in California

The results of a California research project on odors influencing the foraging behavior of spiny lobsters, *Panulirus interruptus*, and rock crabs, *Cancer antennarius*, provide data for lobster and crab fishermen and to those interested in developing artificial baits. University of California at Santa Barbara (UCSB) Sea Grant researchers R. K. Zimmer-Faust and J. F. Case conducted the research on a small rocky reef area 4-7 m deep near the UCSB campus. Elliptically shaped 40″ × 31″ × 12″ polyethylene mesh traps were used. Some of the primary findings were:

1) Live prey (bait) failed to attract lobsters. Mussels, urchins, abalones, polychaete worms, and snails were tested. The results suggest that odors from live prey are not effective in attracting prey. Visual and tactile contact may be necessary in addition to odor.

2) Injured live mussels, urchins, and abalone did attract lobsters.

3) Chopped abalone muscle was most effective and selective in capturing lobsters, while chopped angel shark muscle was most effective and selective in capturing crabs. Angel shark also attracted sheep crab, *Loxorhynchus grandis*. Mackerel was effective for lobsters but gave highly variable results with crabs.

4) Ridgeback shrimp heads and soft tissues of sea urchins were ineffective baits for both crabs and lobsters. The shrimp appeared to repel lobsters.

5) Traps baited with 180 g (6 ounces) of abalone were most effective after 24-48 hours of exposure, but were ineffective by the fourth day. Traps baited with 1,600 g of abalone were most effective after 48-72 hours of exposure and were effective until the seventh day. The researchers suggest that the decomposition of the abalone muscle produces odors stimulating lobster foraging.

Oregon Shrimp Landings Depressed

Oregon shrimp landings for September 1983 totaled 390,000 pounds, compared with 1,696,000 pounds for September 1982. Total cumulative landings through September were about 6.1 million pounds, a decrease of 66 percent from the 17.7 million pounds landed through September 1982.

The number of vessels fishing and the number of deliveries continued to decline, with 35 vessels making 69 deliveries in September. During September 1982, 89 vessels made 213 deliveries. The average catch dropped from 8,000 pounds/trip in 1982 to 5,600 pounds/trip in 1983. Almost all of the shrimp delivered was caught in the Gray's Harbor or Destruction Island area. Fishermen received $0.77-0.80 per pound for their catch. (Source: Oreg. Dep. Fish Wildl., Newport.)

Table 1.—Preliminary Oregon shrimp landings, 1-30 September 1983.

	Landings (1,000 lb)		No. of vessels		No. of deliveries		Season totals (1,000 lb)	
Area	1982	1983	1982	1983	1982	1983	1982	1983
North[1]	1,038	364	40	30	92	60	6,689	[4]3,255
Central[2]	236	26	16	4	33	8	4,315	1,435
South[3]	422	[5]	33	1	88	1	6,722	1,377
Total	1,696	390	89	[6]35	213	69	17,726	6,067

[1]Astoria and Garibaldi.
[2]Newport.
[3]Coos Bay and Brookings.
[4]Includes 51,179 previously unreported during June and July.
[5]Under 1,000 pounds delivered.
[6]May be high due to duplicate counts among some ports.

Record 468-Pound Sturgeon Caught

A 468-pound sturgeon taken ½-mile off Benecia, Calif., by Joey Pallotta last summer has been approved as a new all-tackle world record by the International Game Fish Association, Ft. Lauderdale, Fla. The fish, identified as a white sturgeon by California Fish and Game Department biologists, was estimated at about 100 years old.

Pallotta was fishing from an 18-foot fiberglass boat when the sturgeon took a shrimp bait just a few minutes after his first cast. He radioed a nearby friend in a 26-foot cruiser. When the boat pulled alongside, Pallotta jumped aboard, never releasing the rod. It took 5 hours to subdue the 9-foot fish on 80-pound line.

The catch, made 9 July 1983, broke both the all-tackle record and the 80-pound line class world record of 407 pounds set in the Sacramento River, Colusa, Calif., in 1979. Pallotta, of Crockett, Calif., reportedly donated the huge specimen to the Crockett Historical Society Museum. (Source: IGFA.)

New NMFS Scientific Reports Published

The publications listed below may be obtained from either the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; from the Publications Services Branch (E/AI13), National Environment Satellite, Data, and Information Service, NOAA, U.S. Department of Commerce, 3300 Whitehaven St., Washington, DC 20235; or from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22151. Writing to the agency prior to ordering is advised to determine availability and price, where appropriate (prices may change and prepayment is required).

NOAA Technical Report NMFS SSRF-773. Sedberry, George R. "**Food habits and trophic relationships of a community of fishes on the outer continental shelf**." September 1983, iv + 56 p., 34 figs., 10 tables.

ABSTRACT

The demersal fish community of the Outer Continental Shelf in the Middle Atlantic Bight consists of resident species (*Lophius americanus, Citharichthys arctifrons, Paralichthys oblongus*), seasonal species with boreal affinities (*Raja erinacea, Urophycis chuss, Merluccius bilinearis, Macrozoarces americanus*), and seasonal species with warm-temperate affinities (*Urophycis regia, Stenotomus chrysops*). Although most dominant demersal fishes of the Outer Continental Shelf feed primarily on dense, stable macrobenthic invertebrate communities, some feed on fishes, cephalopods, and planktonic invertebrates. In addition to seasonal changes in prey species preference, food habits change considerably with fish size. Most predator species share many prey species. Overlap in diet among predators varies seasonally, with overlap relationships changing as species and size-class composition of the predators changes. Intraspecific diet overlap between size classes is low, but higher interspecific overlap occurs between species of similar size. Dietary overlap is lowest in the spring, when planktonic and nektonic organisms are consumed by most size classes of dominant predators. Although many important prey species are consumed by several predators, some are selectively consumed by only a few predators, so there is never complete dietary overlap between two species.

NOAA Technical Report NMFS SSRF-777. Love, Milton S., and Mike Moser. "**A checklist of parasites of California, Oregon, and Washington marine and estuarine fishes**." December 1983, 576 p.

ABSTRACT

This report is a summary of the published records of parasites found from the marine and estuarine fishes of California, Oregon, and Washington. Coverage has not been limited to the western United States: It also includes parasite reports from throughout each fish's range. Included is a host-parasite list and parasite-host cross-index.

Toward an Understanding of Salmon Smoltification

Salmon, long North America's most valuable fishery, have the potential for even greater productivity via aquaculture. Hatchery-reared fish have grown in importance, but the smolts must be fully prepared for downstream migration and saltwater survival.

Several annual workshops on salmonid smoltification culminated in 1981 in a formal symposium, the proceedings of which were published in a Special Issue, 28(1-2), of *Aquaculture:* "**Salmonid Smoltification**," the Proceedings of a Symposium Sponsored by the Pacific Sea Grant Advisory Program and the California Sea Grant College Program. Guest editors for the issue were H. A. Bern of the University of California, Berkeley, Department of Zoology, and Conrad V. W. Mahnken of the NMFS Northwest and Alaska Fisheries Center's Manchester (Wash.) Laboratory.

In this Special Issue, prominent researchers present their work on topics important to salmonid development and enhancement. Included are papers on morphological indices of developmental progress in the coho parr-smolt, an ultrastructural study of changes in the endocrine organs of coho salmon during normal and abnormal smoltification, thyroid and steroid hormones for control of salmonid growth and smoltification, factors in the surge in thyroid activity in salmon during smoltification, interrenal function and smoltification, and osmoregulatory changes accompanying smoltification in the coho salmon.

Also discussed is stunting and parr-reversion during coho smoltification, photoperiod control of coho smoltification, circannual rhythms and photoperiod regulation of growth and smolting in Atlantic salmon, precocious sexual maturation and smoltification in male Atlantic salmon, stress and rearing of salmonids, an assessment of size/time requirements for Columbia River hatchery coho salmon releases, criteria for parr-smolt transformation in juvenile chinook salmon, criteria for adaptation of salmonids to high salinity seawater, and more.

The papers are both well written and edited and the volume is a handy reference source for those interested in gaining a better understanding of smoltification and its management in enhancing salmonid survival. Copies of the 270-page Special Issue are available for US$62.00 (DFl.155.00) and prepaid orders should be sent to Elsevier Science Publishers, P.O. Box 330, 1000 AH, Amsterdam, The Netherlands.

NOAA Technical Report NMFS SSRF-778. Braham, Howard W., Bruce D. Krogman, and Geoffrey M. Carroll. "**Bowhead and white whale migration, distribution, and abundance in the Bering, Chukchi, and Beaufort Seas, 1975-78.**" January 1984, 39 p.

ABSTRACT

From September 1975 to September 1977 we conducted field research on bowhead, *Balaena mysticetus*, and white, *Delphinapterus leucas*, whales in the U.S. Bering, Chukchi, and Beaufort Seas. The objectives were to determine the general distribution and migration of these whales in spring and autumn and to estimate abundance. We also surveyed the literature beginning in June 1975 through March 1978 to augment our empirical results.

Bowhead and white whales spend the winter months among the pack ice and open water of the central and western Bering Sea. They migrate into the eastern Chukchi Sea and across the southern and central Beaufort Sea from April through June. Their route takes them along the west side of the northern Bering Sea through Bering Strait, along the northwest coast of Alaska between Point Hope and Point Barrow, generally within 50 km of shore (closer to Point Barrow than off Point Hope and Cape Lisburne), and offshore in the Beaufort Sea generally to within 60 km of the coast (exceptions are pointed out in the text).

Virtually all bowhead migration appears to follow this pattern; however, white whales may be divided into groups (or stocks) of varying sizes, some occurring in Bristol Bay, Norton Sound, Kotzebue Sound, and along the northwest coast of Alaska during summer. The largest component of the white whale population migrates into the Canadian Beaufort Sea in spring at roughly the same time as the bowheads. Autumn migration results were not obtained, generally, for either species.

The 1978 minimum estimate of the bowhead whale population was 1,800-2,900 individuals; for white whales in Alaskan waters it was 9,000-16,000 individuals.

South, Central American Fishery Reports Available

Chilean Fisheries

Chile has become the preeminent Latin American fishing country. The country's 1982 fisheries catch surpassed 4.0 million metric tons (t), a 20 percent increase over the 3.3 million t taken in 1981. The increased catch, however, has not been reflected in increased profits for Chilean companies.

Most of the catch is reduced to fish meal, but low prices for that product affected company earnings in 1981 and early 1982. The Government's exchange rate policy has also affected company earnings. Chilean officials believe that, even with the recent growth of the fisheries catch, there are still extensive unutilized resources that will enable the industry to continue expanding for several years.

The U.S. Embassy in Santiago, Chile, has prepared a 26-page report reviewing Chile's fishing industry. It includes information on the catch, processing, exports, fleet, vessel con-

Chemistry, Biochemistry, and Fish Utilization

"**Chemistry & Biochemistry of Marine Food Products**," edited by Roy E. Martin, George J. Flick, Chieko E. Hebard, and Donn R. Ward, is a new reference published by Avi Publishing Company, 250 Post Road East, P.O. Box 831, Westport, CT 06881. Martin is Director of Science and Technology, National Fisheries Institute, Washington, D.C.; Flick and Hebard are with the Virginia Polytechnic Institute and State University (VPI&SU), Blacksburg, Va.; and Ward is with the VPI&SU at Hampton, Va.

Broad in scope, the volume contains much information useful to those concerned with the utilization of our marine fisheries. It provides excellent reviews of important aspects of seafood technology and by-product utilization, along with recent advances in marine product preservation.

In bringing together currently known data on the chemistry and biochemistry of marine food products, the book is an expansion of a symposium held in 1979 during the American Chemical Society's meeting in Washington, D.C. It is structured to emphasize the importance of those sciences to the complexities of fisheries technology and to provide a deeper understanding of those changes occurring in this resource. The editors also present material and references translated from foreign sources that had not appeared elsewhere in the U.S. scientific literature.

The volume begins with a review of lipid oxidation in fish muscle microsomes. Chapter 2, by John Spinelli and John Dassow, is on the modification and potential uses of fish proteins in the food industry. Also reviewed are recent advances in the chemistry of iced fish spoilage, histamine formation in fish, identification of fish species by isoelectric focusing, properties of fish oils by Maurice E. Stansby, and steroids in mollusks and crustacea of the Pacific Northwest.

Also reviewed are carotenoid pigments in seafood, TMAO in fish and shellfish, heavy metals in fishery products, seafood irradiation by Joseph J. Licciardello and Louis J. Ronsivalli, enzymatic ammonia production in iced penaeid shrimp, effects of processing on clam flavor volatiles, biochemical evaluation of seafood, flavor components in fish and shellfish, effect of heat processing on color characteristics in crustacean blood, utilization of shellfish waste for chitin and chitosan production, blueing discoloration of Dungeness crabmeat by Jerry K. Babbitt, vitamins and minerals in Pacific Northwest seafoods, enzyme modifications of fishery by-products, and preservation of seafood with modified atmospheres.

With growing opportunities to catch, culture, and utilize U.S. seafoods, the

struction, market for U.S. exporters and investors, and Chilean development programs. A copy can be purchased for $5.00 by ordering report number ITA-83-02-002 from the National Technical Information Service (NTIS), Springfield, VA 22161.

Venezuelan Fisheries

Venezuelan fishermen caught about 193,000 t of fish and shellfish in 1981, a 2 percent increase over the 190,000 t taken in 1980. The tuna industry expanded but there was a sharp decline in the sardine fishery. Shrimp fishermen near Lake Maracaibo reported continuing problems with industrial pollution and sewage.

Venezuela, in recent years, has become one of the major Latin American markets for U.S. fishery products. However, Venezuela's deepening economic difficulties and increased competition from Andean Pact partners Ecuador and Peru have forced the government to implement restrictive new trade practices which will affect imports from the United States.

The U.S. Embassy in Caracas has prepared a 15-page report reviewing 1981-82 fishery developments. The report describes the tuna, sardine, and shrimp fisheries, the role of the fishing industry in the national economy, government policy, international relations, import restrictions, and opportunities for U.S. businessmen. A copy can be purchased for $5.00 by ordering ITA-83-03-006 from NTIS.

Mexican Fisheries

The U.S. Fisheries Attache for Latin America stationed at the U.S. Embassy in Mexico City has prepared a 9-page review of the Mexican fishing industry. The report includes information on Mexican fishery policies, catch, tuna, shrimp, fish meal, sport fishing, joint ventures, fleet, consumption, credit, budget, and processing. U.S. companies can order a copy for $5.00 by requesting ITA-83-02-008 from NTIS.

Brazilian Fisheries

Brazil has one of the world's largest coastlines and river systems, but has only begun to exploit its fishery potential.

The U.S. Embassy in Brazilia has prepared a 33-page report on the nation's fishing industry. The report includes 21 statistical tables and information on trade, tuna, sardines, lobster, whales, leasing foreign vessels, and fisheries development. U.S. companies can obtain a copy by ordering ITA-83-02-007 for $5.00 from NTIS.

Ecuadorean Fisheries

Ecuadorean fishery exports increased in 1981, making fishery products the country's most important nonpetroleum export commodity. Almost all of the increase was due to the continued growth of the country's pond shrimp industry.

The U.S. Embassy in Quito has prepared a 19-page report on the Ecuadorean fishing industry. It includes 16 statistical tables and information on shrimp, shrimp culture, tuna, canned products, fish meal, economic development, and research. U.S. companies can obtain a copy by ordering ITA-83-01-003 for $5.00 from NTIS.

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volume should be a very useful reference for those dealing with fisheries technology and utilization. The indexed 474-page hardbound volume has 23 chapters, each with many references, and is available from the publisher for $45.00 in the United States and $49.50 elsewhere.

Progress in Fish Culture Is Reported

"**Recent Advances in Aquaculture**," edited by James F. Muir and Ronald J. Roberts and published by Westview Press, 5500 Central Avenue, Boulder, CO 80301 (and Croom Helm) presents six long reviews on topics of considerable interest to aquaculturists. Muir is a Lecturer in the Institute of Aquaculture at the University of Stirling, and Roberts is Director of the Institute.

In Chapter 1, Donald J. Macintosh, who has extensively studied mangrove ecology at the University of Malaysia, explains the significance of mangroves to both fisheries and aquaculture and describes the distribution and ecology of mangrove swamps, their productivity and energy flow, and mangrove pond culture practices for finfish, prawns, crabs, mollusks, and seaweeds.

Another lengthy chapter by J. F. Wickins relates opportunities for farming crustaceans in western temperate regions, beginning with a brief review of the demand for crustaceans and their biology. Culture options (i.e., prawns, lobsters, crayfish, etc.) are discussed, as is the reuse of water in controlled environment cultures.

The biology and culture of snakeheads, a species popular in the orient, is presented by Kok Leong Wee while Kim Jauncey reviews carp nutrition. The snakehead has higher protein and lower fat content than carp or tilapia, and Wee reviews their systematics, nutritional attributes, economics of their culture, their ecological requirements and air breathing characteristics, life history, fecundity, growth rate, etc. He then discusses snakehead culture and diseases and suggests several areas for future research in disease control, breeding, genetic selection and hybridization, and culture technology.

Another long chapter by John D. Balarin and Rene D. Haller is devoted to the intensive culture of tilapia in tanks, raceways, and cages. Discussed is the suitability of tilapia for intensive culture and intensive fry production, along with nutrition and feeding in intensive culture. Then, the authors give an economic evaluation and future prospects of tilapia culture.

Finally, James F. Muir provides a thorough review of recirculated water systems in aquaculture, discussing operating conditions, overall system design, oxygen supply, nitrogen re-

moval, solids removal, sterilization, chemical oxidation processes, pH control, energy use in recycled systems, system operation and control, husbandry and production management, and economics of recycling systems.

Each chapter discusses practical advances made by the authors and includes many fairly recent (up to about 1981) references. The book will likely be of interest to practicing fish culturists as well as students and scientists. Indexed, the 453-page hardbound volume costs $49.75 or £27.50.

Bacterial and Viral Diseases of Fishes

Expanding interest in fish disease studies culminated in a 1981 symposium of the Society for General Microbiology in Edinburgh, Scotland, and the result of that is "**Microbial Diseases of Fish**," edited by R. J. Roberts and published as the Society's Special Publication No. 9 by Academic Press Inc. (London) Ltd., 24-28 Oval Road, London, England NW1 7DX.

The volume contains 12 well-written reviews: A. E. Ellis explains the difference between the immune mechanisms of fish and higher vertebrates, M. J. Manning et al. review developmental aspects of immunity and tolerance in fish, and P. D. Ward discusses the development of bacterial vaccines for fish. Ken Wolf then reviews newly discovered viruses and viral diseases of fishes between 1977 and 1981 and B. J. Hill reports on infectious pancreatic necrosis virus and its virulence.

Additionally, C. Agius reviews virus diseases of warm water fish, A. L. Munro details the pathogenesis of bacterial diseases of fishes, and C. Michel reports on progress toward furunculosis vaccination. Finally, the pathogenicity of *Vibrio anguillarum* is examined by M. T. Horne while D. J. Alderman discusses fungal diseases of aquatic animals, A. H. McVicar presents an extensive review of *Ichthyophonus* infections of fish, and A. D. Pickering and L. G. Willoughby review *Saprolegnia* infections of salmonids.

In sum, the volume represents a useful and fairly recent synthesis of information on microbial fish pathogens. The 305-page hardbound book is indexed, and each chapter is well documented with references. It is available from the publisher for £21.80 or $40.50.

"**Bacterial and Viral Diseases of Fish: Molecular Studies**," edited by Jorge H. Crosa of the School of Medicine, Oregon Health Sciences University, Portland, has been published as WSG-WO 83-1 by the Washington Sea Grant Program, 3716 Brooklyn Avenue, N.E., Seattle, WA 98105.

The six chapters in this small paperbound volume present recent research on important bacterial and viral diseases of salmonids, and work which might lead to eventual development of successful fish vaccines. The first paper provides a detailed account of the major diseases causing mortality among cultured salmonids and also deals with the methods for preventing and halting the spread of those diseases.

The next three chapters analyze the causative agents of vibriosis and furunculosis. Finally, the molecular study of two viral systems, infectious hematopoietic necrosis (IHN) and infectious pancreatic necrosis (IPN) viruses, are discussed in the last two papers. The small 86-page volume, unindexed, is available from the publisher for $5.00.

A Look at the New England Fisheries

"**Industry in Trouble**," subtitled "The Federal Government and the New England Fisheries," by Margaret E. Dewar, has been published by the Temple University Press, Broad and Oxford Streets, Philadelphia, PA 19122. In it, the author, an Assistant Professor at the Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, reviews the New England fishing industry since World War II, its problems, and the efforts to solve them. She then compares her analysis with Government efforts to aid other U.S. industries (i.e., steel, shoes, merchant marine, shipbuilding, etc.).

Chapter by chapter the author explores the structure and problems of the New England fisheries, efforts at aiding them, shortcomings of intervention, foreign fleets and questions of fisheries control, fishery management implementation, and examines shortcomings in public efforts to revitalize the fisheries.

The author gives her views of the fishing industry problems, how the fishing industry perceived them, the Federal aid or programs to alleviate the problems, and the effects of those programs. Often, she says, the root causes of problems were not fully identified by either the public or private sectors, and thus there were many problems in finding good solutions, and in implementing the programs. She predicts that the fishing industry will continue to face problems, seek government help, and that the effectiveness of that aid will again depend on how well industry, Congress, and administrators learn from the past.

The author has provided an in-depth and relatively unbiased look at the New England groundfish fishery and her primary recommendations are for better analysis of all aspects of the perceived problems of that fishery, along with analysis of the effects of any proposed solutions or programs. The author also suggests some ways that government aid could be more effective and addresses the question about when the government should step in to help an ailing industry. While some may not agree with all of the author's beliefs or suggestions, the book does present a thoughtful analysis which may be useful even beyond the fishing industry. The 252-page hardbound volume is indexed, provides extensive notes and references, and is available from the publisher for $29.95.

Pay Lake, Fish Hauler Directory Published

A directory of pay lakes and live fish haulers in selected states is now available according to the National Marine Fisheries Service. For a free copy, U.S. firms should write Jim Ayers, National Marine Fisheries Service, NOAA, Suite 200, 11215 Hermitage Road, Little Rock, AR 72211, or telephone 501-378-5888.

Editorial Guidelines for *Marine Fisheries Review*

Marine Fisheries Review publishes review articles, original research reports, significant progress reports, technical notes, and news articles on fisheries science, engineering, and economics, commercial and recreational fisheries, marine mammal studies, aquaculture, and U.S. and foreign fisheries developments. Emphasis, however, is on in-depth review articles and practical or applied aspects of marine fisheries rather than pure research.

Preferred paper length ranges from 4 to 12 printed pages (about 10-40 manuscript pages), although shorter and longer papers are sometimes accepted. Papers are normally printed within 4-6 months of acceptance. Publication is hastened when manuscripts conform to the following recommended guidelines.

The Manuscript

Submission of a manuscript to *Marine Fisheries Review* implies that the manuscript is the author's own work, has not been submitted for publication elsewhere, and is ready for publication as submitted. Commerce Department personnel should submit papers under completed NOAA Form 25-700.

Manuscripts must be typed (double-spaced) on high-quality white bond paper and submitted with two duplicate (but not carbon) copies. The complete manuscript normally includes a title page, a short abstract (if needed), text, literature citations, tables, figure legends, footnotes, and the figures. The title page should carry the title and the name, department, institution or other affiliation, and complete address (plus current address if different) of the author(s). Manuscript pages should be numbered and have 1½-inch margins on all sides. Running heads are not used. An "Acknowledgments" section, if needed, may be placed at the end of the text. Use of appendices is discouraged.

Abstract and Headings

Keep titles, heading, subheadings, and the abstract short and clear. Abstracts should be short (one-half page or less) and double-spaced. Paper titles should be no longer than 60 characters; a four- to five-word (40 to 45 characters) title is ideal. Use heads sparingly, if at all. Heads should contain only 2-5 words; do not stack heads of different sizes.

Style

In style, *Marine Fisheries Review* follows the "U.S. Government Printing Office Style Manual." Fish names follow the American Fisheries Society's Special Publication No. 6, "A List of Common and Scientific Names of Fishes from the United States and Canada," third edition, 1970. The "Merriam-Webster Third New International Dictionary" is used as the authority for correct spelling and word division. Only journal titles and scientific names (genera and species) should be italicized (underscored). Dates should be written as 3 November 1976. In text, literature is cited as Lynn and Reid (1968) or as (Lynn and Reid, 1968). Common abbreviations and symbols such as mm, m, g, ml, mg, and °C (without periods) may be used with numerals. Measurements are preferred in metric units; other equivalent units (i.e., fathoms, °F) may also be listed in parentheses.

Tables and Footnotes

Tables and footnotes should be typed separately and double-spaced. Tables should be numbered and referenced in text. Table headings and format should be consistent; do not use vertical rules.

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Title the list of references "Literature Cited" and include only published works or those actually in press. Citations must contain the complete title of the work, inclusive pagination, full journal title, and the year, month, volume, and issue numbers of the publication. Unpublished reports or manuscripts and personal communications must be footnoted. Include the title, author, pagination of the manuscript or report, and the address where it is on file. For personal communications, list the name, affiliation, and address of the communicator.

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All figures should be clearly identified with the author's name and figure number, if used. Figure legends should be brief and a copy may be taped to the back of the figure. Figures may or may not be numbered. Do not write on the back of photographs. Photographs should be black and white, 8 × 10 inches, sharply focused glossies of strong contrast. Potential cover photos are welcome, but their return cannot be guaranteed. Magnification listed for photomicrographs must match the figure submitted (a scale bar may be preferred).

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Finally

First-rate, professional papers are neat, accurate, and complete. Authors should proofread the manuscript for typographical errors and double-check its contents and appearance before submission. Mail the manuscript flat, first-class mail, to: Editor, *Marine Fisheries Review*, Scientific Publications Office, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E., Bin C15700, Seattle, WA 98115.

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